emerge
one-to-one laptop learning
Transforming Learning, Inspiring Discovery

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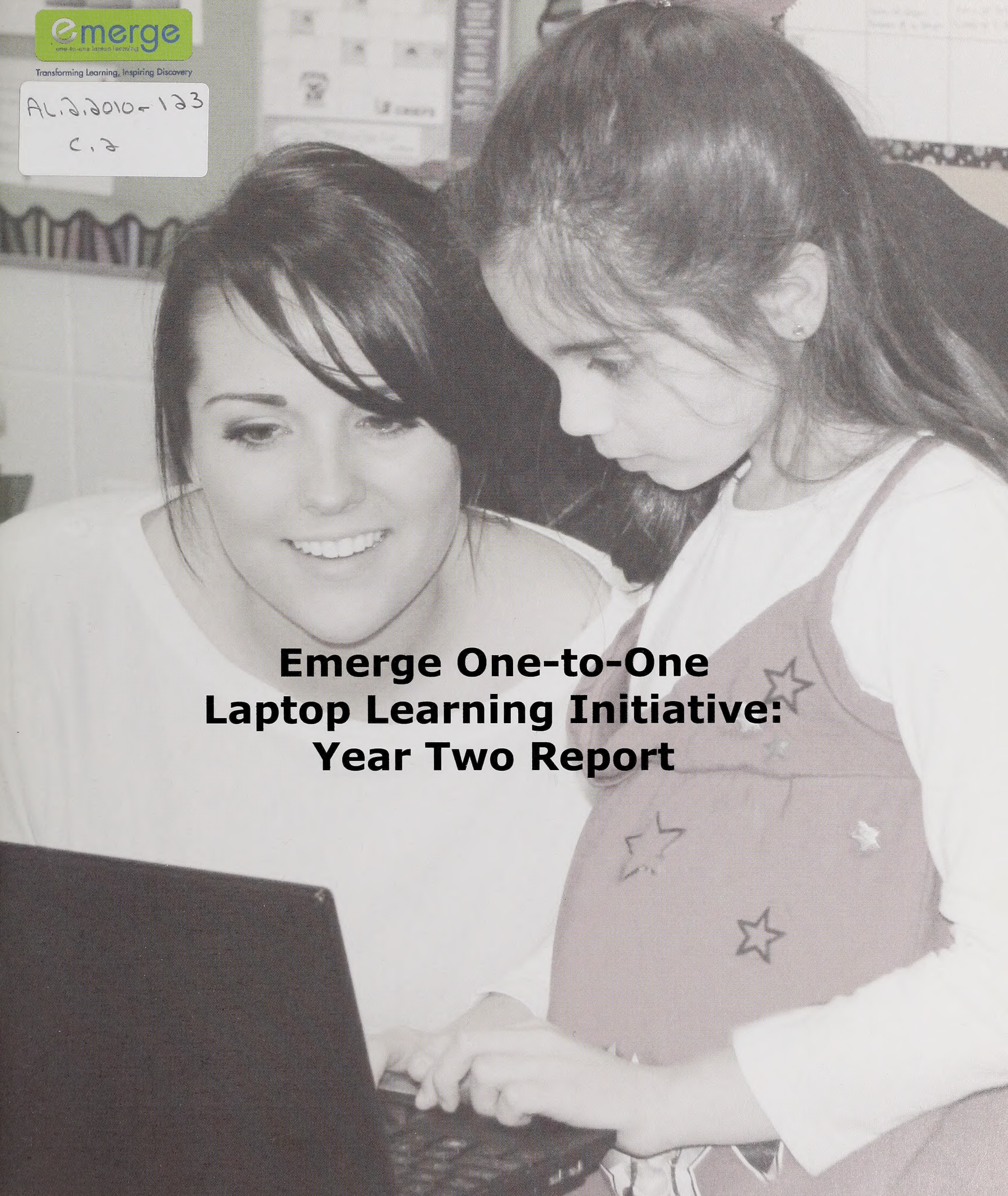

Emerge One-to-One Laptop Learning Initiative: Year Two Report

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Government of Alberta

Emerge One-to-One Laptop Learning Initiative: Year Two Report

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Table of Contents

Executive Summary 1
Years 1-2 Emerge Evaluation Results (2007-2009) 8
  Evaluation Design 9
  Methodology 11
Question 1: Potential Educational Benefits. 12
  Student Attainment of 21st Century Skills 13
  Student Engagement 22
  Self-Directed Learning Inventory (SLI) 28
Question 2: Technical Merits and Innovative Practices 33
  Wireless Networks 33
  Technical Support 33
  Sustainability 33
Question 3: Lessons Learned from Emerge 35
  Administrative Support is Generally Supportive 35
  Professional Development Programs 36
  Rubrics are the Current Assessment of Choice for 21st Century Learning 36
  Trends May Evolve into Lessons Learned 36
Question 4: Readiness for 21st Century Learning/Technology 38
  Dimension 1: Forward Looking, Shared Vision 40
  Dimension 2: Systems Thinking 42
  Dimension 3: 21st Century Skills and Instructional Approaches 44
  Dimension 4: 21st Century Learning Environments 48
  Dimension 5: Educator Proficiency in 21st Century Learning 51
  Dimension 6: Access and Infrastructure 53
  Dimension 7: Accountability/Results 55
  Sources 58
  Appendix A: 21st Century Skills 59
  Appendix B: Data tables 62

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Executive Summary

The Emerge One-to-One Laptop Learning Project (Emerge) was established in 2006 by Alberta Education to investigate the efficacy of laptops for teaching and learning in the 21st Century. Alberta Education used a competitive process in 2007 to award three-year grants to 20 jurisdictions, involving 50 schools.

Each of the 20 jurisdictional grantees selected a specific target population, or 21st Century Skill set as a focus for their three-year grant award. Many of the Emerge jurisdictions focused on a common set of 21st Century Skills including critical thinking, collaboration, global awareness, and information, communications, and technology (ICT). See Appendix A to see the range of 21st Century Skills.

Emerge Implementation Models

In some Emerge programs, the laptops followed the students, while in other jurisdictions the laptops stayed at specific grade levels, with new groups of students participating each year of the program. Many jurisdictions used hybrid approaches that included both models. The jurisdictions also instituted varied policies and practices as to whether students took the computers home.

The Emerge jurisdictions deployed one-to-one laptop learning at specific grade levels or with specific student populations within their targeted schools. None of the Emerge programs were school-wide deployments. While in some Emerge programs the laptops followed the students (for as long as those students were enrolled in the host school), other jurisdictions made the decision to keep the laptops at specific grade levels, which meant inviting new groups of students into the program each year. Still others had hybrids of the two approaches.

This report presents the trends in Emerge jurisdictions across the first two years of the three-year initiative. These trends provide initial, mid-term answers to the research questions for the three-year study of Emerge, as identified by Alberta Education:

1. What are the potential educational benefits of one-to-one laptop learning?
2. What are the technical merits and innovative practices in one-to-one wireless learning?
3. What expertise, experience, and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?
4. What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?
5. What are the trends and/or variances across indicators over time?

Note: The first four research questions are specifically addressed in separate sections of this report. The fifth question is answered in the trends and findings within those four sections.

A mixed method of evaluation has been used since the inception of the initiative. The design involved an initial alignment of indicators and measures to the research questions. Then data were collected, analyzed, triangulated, and reported in Years 1 and 2 based on surveys of teachers, administrators, and project leads, as well as data from site observations in each of the 20 jurisdictions; and observations at Emerge events. The trends based on the surveys and the site visitation data are based on a baseline of Fall 2007 and the most recent data collection from Spring 2009. The trends for student data include pre and post tests only for those students who have been involved in Emerge for a full year in a mature program (which is only Year 2). Therefore, **Time 1** represents the baseline for student data that includes students who entered the program in both Fall 2007 and Fall 2008. The **Time 2** posttest scores are from Spring 2009. The Year 1 baseline report limited findings to a single research question: *What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?* This Year 2 report addresses all five evaluation questions (listed on previous page).

At the beginning of Year 1, the leading indicators for Emerge province wide were Forward Looking, Shared Vision and Access/Infrastructure.

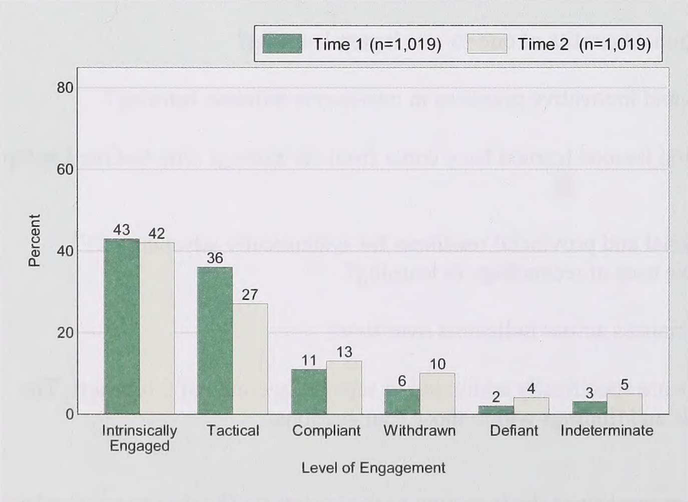
Now, at the end of the second year, the Emerge schools are closing the gap between the lagging and leading indicators, with the 20 jurisdictions, in the aggregate, reporting significant gains in the indicators of 21st Century Learning Environment and Educator Proficiency with 21st Century Learning.

Engagement is much more dependent on the depth, quality, and innovation of learning made possible through the technology and digital media, rather than on the technology itself.

A common theme across the jurisdictions in the second year of the Emerge initiative has been a shift in focus from the technological to the pedagogical. The chrysalis of the Emerge classrooms is transforming as teachers, students, and administrators learn through experience how to tap into the power of the technology to advance academic and 21st Century Learning goals.

Student engagement in Emerge spiked the first year, due in part, to the novelty of the technology for teachers and students alike. Levels of student engagement in Year 2 are much more dependent on the depth, quality, and innovation of learning made possible through the technology, rather than on the technology itself. This, coupled with the fact that students are a year or two older, and engagement decreases as students progress upward through the grades, contributed to a slight decline in the engagement of students over time, as seen in Figure 1.

Figure 1: Trends in Student Engagement in Years 1-2



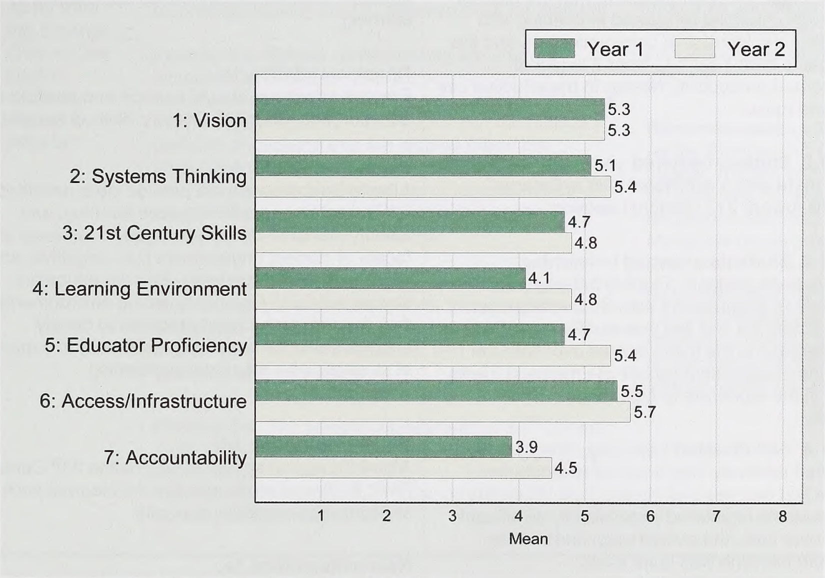
The status of Emerge jurisdictions in establishing 21st Century Learning environments was documented by tracking the level of systemic change in classrooms, schools, and jurisdictions. Based on Metiri Group's Dimensions21 framework, seven interdependent indicators of the current status and readiness for

21st Century Learning were measured, based on surveys of teachers and administrators:

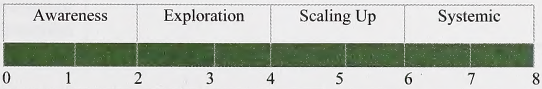
1. Forward Looking, Shared Vision
2. Systems Thinking
3. 21st Century Skills and Learning Approaches
4. 21st Century Learning Environment
5. Educator Proficiency with 21st Century Learning
6. Access and Infrastructure
7. Accountability/Results

Figure 2 provides a look at the trends from Year 1 (Fall 2007) to Year 2 (Spring 2009), as determined by weighted scoring of the teacher and administrator surveys. The surveys were administered between November 2007 and January 2008, based on the return of ethics forms. In some jurisdictions these data were collected prior to the start of the program, in others, these data were collected during the first few months of the program.

Figure 2: Trends Across Years 1-2 - Mean Dimension Scores



Year 1 *N* =108 Teachers; 46 Administrators
Year 2 *N* =129 Teachers; 46 Administrators



Results indicate that the 20 Emerge jurisdictions are at various stages of transformation toward 21st Century Learning. Metiri Group's experience with readiness indicators suggests that schools in the initial stages of launching one-to-one laptop programs typically report two leading (i.e., higher scoring) indicators: *Vision* and *Access/Infrastructure*. The other indicators increase in iterative stages once the school begins implementation. With few exceptions, the Emerge schools followed this pattern. At the start of the Emerge program, the leading indicators were *Vision* and *Access/Infrastructure*.

Now, at the end of the second year, the Emerge schools are closing the gap between lagging and leading indicators, with the 20 jurisdictions, in the aggregate, reporting significant gains in the indicators of *21st Century Learning Environment* and *Educator Proficiency with 21st Century Learning*, and slightly smaller gains in *Systems Thinking* and *Accountability*.

In support of the jurisdictional learning curves in 21st Century Learning, the researchers have, in addition to this report, provided formative Year 2 reports for each jurisdiction and the province, which were shared at the summer Emerge Institute. Those reports are being used by many jurisdictions to set targets for the third year of the program.

The major findings listed below represent the Trends from Years 1-2, with data collected and analyzed at time points across the two years.

Table 1: Year Two Findings and Recommendations

Question	Findings	Recommendations
1. What are the potential educational benefits of one-to-one laptop learning?	**Finding 1.1. 21st Century Skill Attainment**. Student expertise with 21st Century Skills has increased over the course of the two-year program, with the highest levels of such expertise registered in teaming and collaboration and interactive communication, and the greatest gains from Year 1 to Year 2 in global awareness and productivity related to the effective use of real-world tools. **Finding 1.2. Student-centered Learning.** By the end of Year 2 there was a significant shift in Emerge classrooms toward 21st Century Learning. **Finding 1.3. Students engaged in learning.** Elementary-level students (Grades 3-5) reported higher levels of engagement than Secondary-level students across the first two years of Emerge. Despite a slight decrease in the mean scores over time, on average, the engagement scores of Emerge students remained in the moderate to high range. **Finding 1.4. Self-directed Learning.** Emerge students had relatively high levels of self-direction across the first two years of the program. While the Emerge students registered a statistically significant decrease over time, the overall magnitude of the change from baseline was quite small.	**Recommendation 1a:** Jurisdictions should continue to mature and scale student-centered, inquiry-based approaches to learning. **Recommendation 1b:** Emerge educators should support and scaffold self-direction and other 21st Century Skills in students. **Recommendation 1c:** Alberta Education should provide clear definitions for student engagement in deep learning, and identify research-based strategies to increase all facets of student engagement (i.e., cognitive, socio-emotional, and behavioral). Emerge educators should build 21st Century Learning environments that use research-based practices to deeply engage students in learning, especially in support of students who are under-performing academically. **Recommendation 1d:** Albert Education should clearly define 21st Century Skills for the province and should integrate such skills into the provincial curricula. **Recommendation 1e.** Alberta Education should provide leadership in the assessment of 21st Century Learning, explicitly addressing the alignment with the content areas.

Question	Findings	Recommendations
2. What are the technical merits and innovative practices in one-to-one wireless learning?	**Finding 2.1.** The Emerge programs have established **wireless networks** that are, in general, adequately meeting the basic requirements of most Emerge one-to-one programs. **Finding 2.2.** The level of **technical support** varies across the jurisdictions. Some jurisdictions have dedicated staff assigned to the program, whereas other jurisdictions have incorporated the Emerge support into their overall district support. **Finding 2.3.** Emerge programs are actively exploring **options for sustainability** beyond the grant period.	**Recommendation 2a:** Emerge programs should be considering how to sustain, support, maintain, and grow the technologies and associated peripherals, technical assistance, and supplies and materials for the Emerge classrooms beyond the grant period. **Recommendation 2b:** Innovative models of students' ubiquitous access to technology under discussion within the Emerge program should be documented and shared, along with analyses of pros and cons to each model.
3. What expertise, experience, and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?	**Finding 3.1.** The Emerge educators (teachers and administrators) have made steady progress in their proficiency with technology and 21st Century Learning. There seems to be a natural progression in such learning that necessitates the teachers' acquisition of technology fluency prior to effective uses for learning. **Finding 3.2.** School administrators are showing increased appreciation and support for the accomplishments of the Emerge classrooms. Some of the Emerge programs, when faced with the difficult decision of deciding that the laptops follow the students or the laptops stay at grade level with a teacher, chose to buy a new set of laptops, which enabled them to do both. This was due in part to parental and community influence. **Finding 3.3.** The Emerge programs include a range of professional development models including: job-embedded professional development, online and face-to-face communities of practice, and in school coaching and mentoring. **Finding 3.4.** The primary assessment of 21st Century Skills and Learning in the Emerge program is achieved by the use of rubrics (e.g., for students' digital projects, authenticity, engagement, critical thinking, collaboration, etc.).	**Recommendation 3a:** Now that models of one-to-one laptop learning are emerging (e.g., combinations of technologies, policies on home/school use, student-owned devices in schools, etc.), innovative leadership programs should be developed that build the capacity of teachers, administrators, and policymakers to select, support, and scale such models. **Recommendation 3b:** As the Emerge 21st Century Learning programs mature, models of innovative classrooms and schools, and professional development (e.g., embedded coaching, mentoring, just-in-time, etc.) should be documented, shared, and expanded. **Recommendation 3c:** The 20 jurisdictional Emerge programs should be requested to report information, where appropriate, on the impact of the one-to-one laptop program with special needs populations.

Question	Findings	Recommendations
4. What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?	**Finding 4.1.** The Emerge jurisdictions made progress on six of the seven dimensions of readiness for 21st Century Learning. **Finding 4.2.** The Emerge teachers now – in Year 2 – have a deeper understanding of and commitment to the Vision for 21st Century Learning in their respective Emerge projects. **Finding 4.3.** The Emerge leaders have maintained the depth and breadth of their support for Emerge one-to-one laptop learning throughout the program. **Finding 4.4.** Over the course of the first two years of Emerge, the perception of teachers regarding the relevance of the 21st Century Skills to content has shifted. Previously, teachers highly valued productivity and communication; now they more highly value the use of tools in critical thinking, creativity, and ethical use. **Finding 4.5.** Classroom practices in the Emerge program have shifted during the first two years toward 21st Century Learning, while maintaining a modicum of traditional, didactic teaching. **Finding 4.6.** Nearly a third of Emerge teachers are indicating that interactions with students' parents are "strongly facilitated by technology." **Finding 4.7.** Teacher proficiency with technology in advancing academic proficiency and 21st Century Skills has increased over the two years of Emerge. **Finding 4.8.** Emerge teachers and administrators report having adequate access to computers and other peripherals, but do report some gaps in the access to more specialized technologies and to maintenance items such as batteries. **Finding 4.9** While the majority of Emerge teachers report having access to fast reliable Internet connections, there remain a significant percentage (29%) of Emerge teachers who report that they do not yet have such access, with reliability of the Internet connections more problematic than speed. **Finding 4.10.** The percentage of teachers who reported their students clearly understood what would be required to demonstrate their attainment of 21st Century Skills increased from Year 1 to Year 2. Many teachers are using rubrics for the assessment of 21st Century Skills and for 21st Century Learning.	**Recommendation 4a:** During the last year of the Emerge program, educators and leaders should focus on moving all indicators into the systemic category, based on their Year 2 reports from the researchers. **Recommendation 4b:** Emerge exemplars from curriculum, instruction, and assessment practices should be documented and shared. **Recommendation 4c:** Emerge leaders should expand the virtual communities of practice concept to promote collaborations and exchanges across the Emerge jurisdictions. The recommendations in Sections 1-3 also address some of the findings in this section.

Overall, the trend data demonstrate that the 20 Emerge jurisdictions are fairly well staged to succeed. Most have established sound technology systems to support such learning. They have established policies and practices that leverage new approaches to learning made possible through these digital tools and the Internet access. While they have also made great strides in establishing 21st Century Learning environments, much is left to accomplish, especially in optimizing such systems through appropriate assessments.

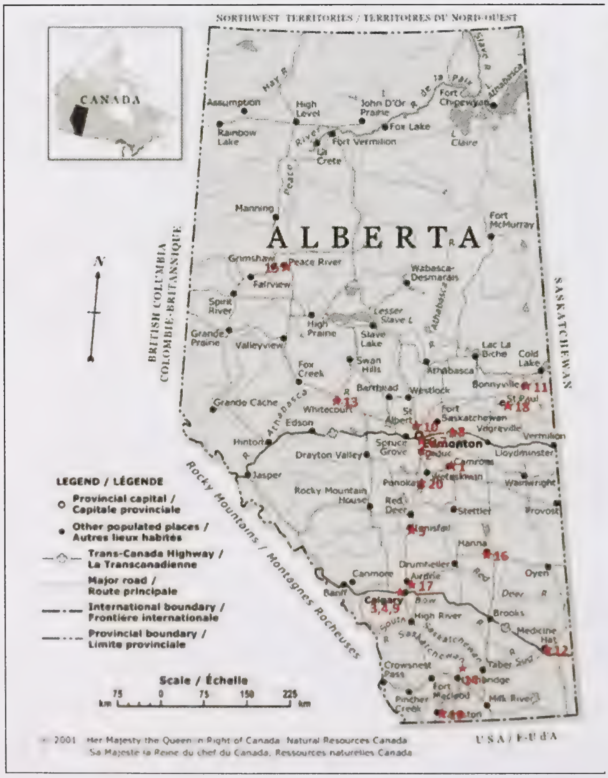
It will be critical in this last year of Emerge to turn leaders' attention to identifying the value that adding the laptops and associated instructional approaches bring to the education of students, and the system changes required to implement such approaches. Once those critical elements are identified, the jurisdictions will need to explore options for sustaining and scaling up the features of the Emerge project deemed to add value.

Years 1-2 Emerge Evaluation Results (2007-2009)

The Emerge One-to-One Laptop Learning Project is a province wide program launched in 2007 by Alberta Education to investigate the efficacy of one-to-one wireless computing for learning and teaching. In the spring of 2006, the province issued a request for proposal (RFP) to competitively award jurisdictions with 3-year grants. Prior to the proposal deadline, a conference was held for proposal writers at which international leaders in educational technology and 21st Century Learning were featured. The RFP required that applicants focus the vision for their proposed projects on the use of one-to-one laptop learning on student attainment of 21st Century Skills.

Alberta Education awarded 20 jurisdictions with 3-year grants in the spring of 2007. The project annually impacts approximately 2,500 students, 170 teachers, and 50 administrators within 50 schools in 20 Alberta jurisdictions. Through subsequent competitive processes, the Galileo Educational Network Association, a consultant group from Calgary, was contracted to provide professional development for the program, and the Metiri Group and the University of Calgary were contracted as the research/evaluation team.

Alberta Education sponsors a province wide community-of-practice day each fall and spring, targeted professional development experiences that are responsive to Emerge participants, and a summer event to facilitate professional and programmatic growth within Emerge.



Number	School/District
1	Battle River Regional Division
2	Black Gold Regional Division
3	Calgary Roman Catholic Separate School District
4	Calgary Board of Education
5	Chinook's Edge School Division
6	Edmonton Catholic Separate School District
7	Edmonton School District
8	Elk Island Public Schools Regional Division
9	Greater Southern Separate Catholic Francophone Education Region
10	Greater St. Albert Catholic Regional Division
11	Lakeland Roman Catholic Separate School District
12	Medicine Hat School District
13	Northern Gateway Regional Division
14	Palliser Regional Division
15	Peace River School Division
16	Prairie Land Regional Division
17	Rocky View School Division
18	St. Paul Education Regional Division
19	Westwind School Division
20	Wolf Creek School Division

Evaluation Design

Metiri Group and the University of Calgary, hereafter referred to as the researchers, are conducting a study that includes a descriptive evaluation of the provincial program as well as a small, quasi-experimental design study of the impact of the laptop program within one of the Emerge jurisdictions. Alberta Education established advisory committees for the professional development and the research, which meet bi-annually with Alberta Education and the contractors to provide advice and consultation.

The first year (school year 2007-2008) involved many technical and logistical challenges as the wireless systems in each of the 50 schools were installed, laptops were assigned to students and teachers, policies were established, technical assistance provided, teachers and administrators attained expertise and insight through professional development experiences, and the learning with laptops began in classrooms across the province.

The program has now completed its second year. The Emerge school implementations within the 20 jurisdictions differed considerably by grade level, content focus, inclusion of special student populations, and length of participation of students and teachers across the three years. Some schools established programs in which the laptops were assigned to specific grades, which resulted in the same teachers, but different students using them each year. Others decided that the laptops would follow the students (as long as the students remained in the Emerge school), which meant that the same students, but often, different teachers, were assigned the laptops in the second and third years of the program.

The objectives of the three-year study of Emerge, as identified by Alberta Education at the inception of the program were to:

- Establish and support a research-based, one-to-one laptop learning community of practice.
- Further investigate the potential educational benefits of one-to-one laptop learning.
- Identify technical merits and innovative practices in one-to-one laptop learning.
- Share expertise, experience and lessons learned related to one-to-one wireless learning.
- Inform and support one-to-one laptop learning implementations within Alberta's learning system.

To those purposes, the Emerge evaluation was designed to answer the following research questions:

1. What are the potential educational benefits of one-to-one laptop learning?
2. What are the technical merits and innovative practices in one-to-one wireless learning?
3. What expertise, experience, and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?
4. What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?
5. What are the trends and/or variances across indicators over time?

The researchers plan included a mixed methods evaluation and a quasi-experimental design research study. The research team introduced interim evaluation questions based on the objectives established by Alberta Education. The first year report completed in the fall of 2008 provided baseline data. This Year 2 report provides a first look at trends over the two years related to the research questions above.

The combination of the two sets of questions frame the evaluation work. As of the date of this report, the researchers have completed year one and two evaluations and provided customized data reports to the 20 jurisdictions along with an aggregated provincial report to Alberta Education. In addition, they have participated in capacity building events, finalized the quasi-experimental design (QED) for a small research study, and have begun conducting the QED in one of the 20 Emerge jurisdictions.

As background, the overall mission of schools is to ensure that students acquire the skills, knowledge, processes, and dispositions that enable them to meet or exceed provincial learning standards. For increasing numbers of schools, those standards include academic and 21st Century learning goals, goals that will prepare them to thrive in today's global, high tech society and workplace. The design used in the evaluation is grounded in Metiri Group's Dimensions21 framework for 21st Century Learning. It includes definitions of 21st Century Skills and seven interdependent indicators of readiness of a school or district for 21st Century Learning.

1. Forward Looking, Shared Vision
2. Systems Thinking
3. 21st Century Skills and Learning Approaches
4. 21st Century Learning Environment
5. Teacher Proficiency with 21st Century Learning
6. Access and Infrastructure
7. Accountability/Results

In addition to the data collected at the school level, the descriptive evaluation also includes constructs and instruments to measure student engagement, student perceptions of how engaging they find their classrooms, and student self-direction as described below.

Self-directed Learning Inventory (SLI)

Self-directed learning is defined as the propensity to set goals related to learning, plan for the achievement of these goals, independently manage time and effort, and independently assess the quality of learning and any products that result from the learning experience. Self-direction is more directly linked to academic success than virtually any other student characteristic. Research indicates that skills of self-direction can be taught, scaffolded, and promoted through the implementation of simple but powerful strategies (see Hwang & Liu, 1994; Schunk & Zimmerman, 1998; Zimmerman, 1990). The data in the section on self-directed learning was collected through Metiri Group's Self-directed Learning Inventory (SLI). That instrument assesses the levels of student self-direction at three phases of the learning process: *Forethought*, *Performance/Volitional Control*, and *Self-Reflection.*

Student Engagement Survey (SEI)

Student engagement is defined as, "the degree to which students are actively pursuing deep learning related to established standards" (Fredricks, Blumenfeld, & Paris, 2004). The researchers report here the current levels of engagement as reported by individual students. Students in the Emerge program completed Metiri Group's Student Engagement Inventory online. The data from those surveys were then analyzed and aggregated to report the percentage of students at five different levels of engagement: *Intrinsically Engaged*, *Tactical*, *Compliant*, *Withdrawn*, or *Defiant*. Only matched sets of data were included in the analysis of this Year 2 report.

Classroom Structures to Engage Students (CSES)

This section looks at student perceptions of conditions in the school that have been linked by research to increases in student engagement. The Metiri Group survey, *Classroom Structures that Engage Students* (CSES), asked students to share their perceptions on characteristics of learning environments that research indicates are directly related to the level of student engagement in learning. These characteristics include content (i.e., choice, substance, structure, and variety), process (i.e., intellectual safety, affiliation, and affirmation), and product (i.e., product standards, product focus, and authenticity).

Methodology

The methodology used to collect and analyze data and report results includes the triangulation of data based on indicators from that framework. These data were collected through the instruments included in Table 2, on a time line outlined in that same table.

Table 2: Evaluation instruments and time points of administration in Years 1 and 2 of Emerge

Instruments	*Baseline*	*Spring '08*	*Fall '08*	*Spring '09*
Surveys of teachers	X		Only those new to Emerge	X
Surveys of administrators	X		Only those new to Emerge	X
Surveys of points of contact	X	X	X	X
Site visits to each of the 20 jurisdictions	X	X		X
Student surveys of self-directed learning	X	Only students exiting Emerge	Only students new to Emerge	X
Student surveys of engagement	X	Only students exiting Emerge	Only students new to Emerge	X
Student surveys of their perceptions of classroom/school structures relevant to engagement	X	Only students exiting Emerge	Only students new to Emerge	X

In order to answer the question–"Does providing ubiquitous access to laptops impact students in the long term?"—it is necessary to follow students over multiple years and track their attitudinal and learning outcomes. This report presents the findings using a longitudinal time series analysis[1] on a subset of student data collected from multiple time points. The student findings presented in this section are based only on these students. Paired sample *t*-tests comparing pre (Time 1) and post (Time 2) results were used to statistically determine if a significant difference between the two scores existed.[2]

The researchers also collected observational data and received feedback through their participation at the events and seminars scheduled by Alberta Education throughout the year. It should also be noted that, while the researchers used student data that is matched from pretest to posttest, they were precluded from doing so for Emerge educator data due to the relatively small number of Emerge teachers and administrators, and a second year implementation that moved the laptops on to new teachers,.

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[1] In their book, *How to Design a Program Evaluation*, Fitz-Gibbon and Morris distinguish between the two types of time series analysis. They write: "Time series analysis comes in two varieties. One involves measurements of the same group of students. This can be called a longitudinal time series analysis, as to distinguish it from the more common variety, the successive time series" (p. 60-61). Longitudinal research has benefits that can only be attained by looking at something over a period of time.

[2] Statistical significance indicates whether data is worth paying attention to, rather than a statistical fluke. The term "significant" is not intended to indicate a judgment about the degree or the educational relevance of the differences. Rather it is intended to identify statistically dependable population differences in order to help inform dialogue.

Question 1: Potential Educational Benefits.

What are the potential educational benefits of one-to-one laptop learning?

The intent of the Emerge program was to explore the efficacy of one-to-one laptop computing in the deepening of learning and attainment of 21st Century Skills, especially as it pertains to special populations of students. This evaluation report provides descriptive evidence and analysis of trends in these areas.

Overall results suggest that system changes are underway in Emerge classrooms toward more student-centered, experiential learning. In addition, there is some initial evidence of the impact on students related to student attainment of 21st Century Skills, student engagement, and student self-directed learning. The researchers will work with Alberta Education to report on the experience of special populations in the Emerge program during Year 3 only.

Potential Educational Benefits

The potential educational benefits to one-to-one laptop learning are high levels of:

1. *Authenticity of student learning*
2. *Independence of students in learning*
3. *Attainment of 21st Century Skills*
4. *Engagement of students in deep, complex, relevant learning*
5. *Self-directed learning*
6. *Readiness of students to thrive in a complex, global, high tech society*

The potential educational benefits to one-to-one laptop learning are listed in the box to the right. The evidence basis for these potential benefits at this interim stage in Emerge can be found in the four findings that follow, plus the 11 findings in Section 4 on System Readiness. In addition, at the end of this section, the researchers have provided recommendations for consideration by Alberta Education and the Emerge participants in the third and final year of the program and beyond.

Student Attainment of 21st Century Skills

Finding 1.1

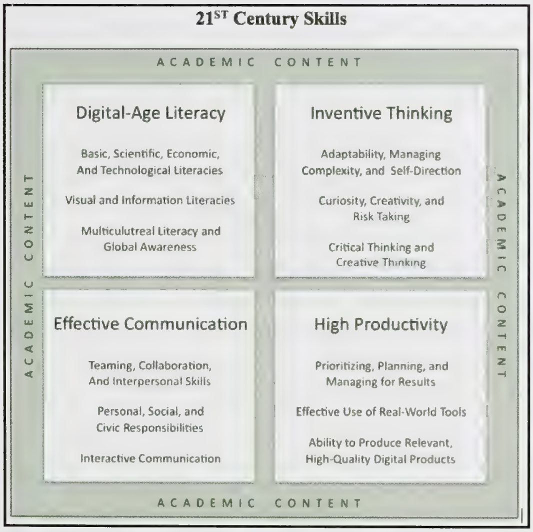
Student expertise with 21st Century Skills has increased over the course of the two-year program, with the highest levels of such expertise in Teaming and Collaboration and Interactive Communication. The greatest gains from Year 1 to Year 2 were registered in Global Awareness and Productivity related to the effective use of real-world tools.

Discussion

There are calls from business, industry, government, and community, for education to prepare graduates to contribute to economic viability locally and nationally. Education is under fire to prepare graduates for a highly collaborative, innovative, high tech, global workforce. For example, a 2009 research study by a U.S. Stanford University professor identifies causal links between high cognitive teaching and learning in schools and the economic growth and health of states and nations (Hanushek & Woessman, 2009).

One of the purposes of the Emerge initiative is to advance 21st Century Skills attainment among students. At the inception of the Emerge programs, the 20 jurisdictions committed to addressing 21st Century Skills, but discussed 21st Century Skills in general, rather than zeroing in on specific goals. During the first year of the program the Emerge participants became more knowledgeable about the range of 21st Century Skills, and narrowed their focus to just a few skills. The most common of those were *Critical Thinking, Collaboration,* and *Self-Directed Learning.* A figure that includes the range of 21st Century Skills is included in Figure 3 for background. (See also Appendix A.)

Figure 3: enGauge 21st Century Skills

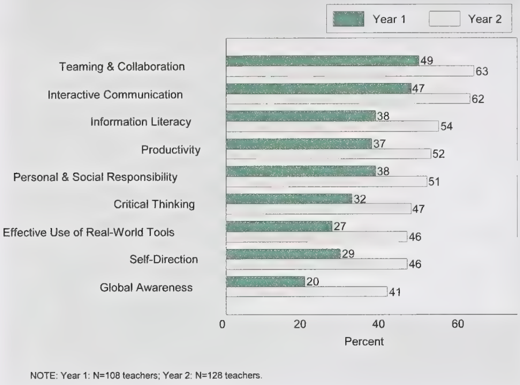

21ST Century Skills
ACADEMIC CONTENT
Digital-Age Literacy
Basic, Scientific, Economic, And Technological Literacies
Visual and Information Literacies
Multiculutreal Literacy and Global Awareness
Inventive Thinking
Adaptability, Managing Complexity, and Self-Direction
Curiosity, Creativity, and Risk Taking
Critical Thinking and Creative Thinking
Effective Communication
Teaming, Collaboration, And Interpersonal Skills
Personal, Social, and Civic Responsibilities
Interactive Communication
High Productivity
Prioritizing, Planning, and Managing for Results
Effective Use of Real-World Tools
Ability to Produce Relevant, High-Quality Digital Products
ACADEMIC CONTENT
ACADEMIC CONTENT
ACADEMIC CONTENT

Source: enGauge 21st Century Skills by NCREL and Metiri Group

A challenge in capturing the overall status of this work across jurisdictional projects is that each project established its own goals related to which skills would serve as a primary focus. Thus, while this provincial level evaluation is reporting teacher perceptions as to their students' attainment of 21st Century Skills, the reader should recognize that only select skills were purposely addressed within the Emerge program.

According to teachers (see Figure 3), student expertise with 21st Century Skills has increased over the course of the two-year program, with the highest levels of such expertise registered in *Teaming and Collaboration* and *Interactive Communications*, and the greatest gains from Year 1 to Year 2 in global awareness and productivity related to the *Global Awareness* and *Effective Use of Real-World Tools*. The percentage of teachers who rated their students' expertise level as *Intermediate* or *Expert* increased from Year 1 to Year 2 for all skills.

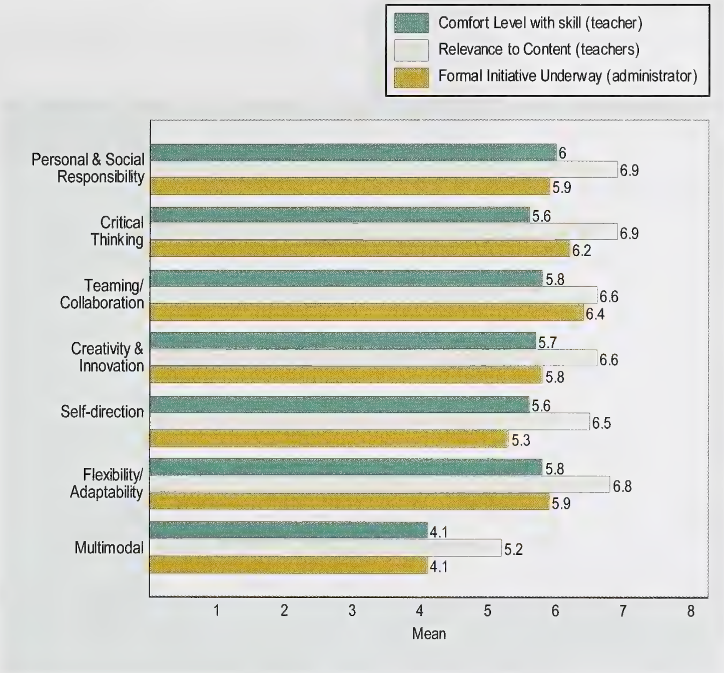
Figure 4. Percentage of teachers reporting their students' expertise in each 21st Century Skill as Intermediate or Expert.



The research team noted through webinars and discussions with points-of-contact that *Critical Thinking* and *Teaming and Collaboration* were priorities for many of the Emerge programs. A closer look at Figure 4 reveals that, while significant gains have been made in both, less than 50 percentage of teachers indicated that the skill level of their students was at the *Intermediate* or *Expert* levels in *Critical Thinking*

Teachers were queried as to the level of *Relevance* of each 21st Century Skill to the content they teach and their current *Comfort Level* with teaching the skill. Simultaneously, administrators were asked if there were any *Formal Initiatives Underway* to address the skill within their district or school. The results of those queries are displayed in Figure 5. The researchers would expect that the three indicators (i.e., *Relevance, Comfort Level,* and *Formal Initiatives)* would be aligned in a school or district that is staged well for 21st Century Learning. A closer look at Figure 4 indicates a gap between levels of *Relevance to Content* and *Formal Initiative Underway* for the skills of *Self-direction* and *Multimodal [Learning].* Also, the largest gaps registered between the levels of *Relevance to the Content* and *Comfort Level with Skill* (by teacher) were for the skills of *Critical Thinking* and *Multimodal [Learning].*

Figure 5. Teacher and administrator responses regarding 21st Century Skills



N=129 teachers and 46 administrators

21^{st} Century Learning

Finding 1.2

By the end of Year 2 there was a significant shift in Emerge classrooms toward 21^{st} Century Learning.

Discussion

21^{st} Century Learning is defined here as learning that embodies the effective use of emergent research on how people best learn; contemporary technologies; and one or more 21^{st} Century Skills.

In identifying 21^{st} Century Learning in Emerge schools, the research team looked for the following indicators:

- 21^{st} Century Skills focus
- Instructional style conducive to 21^{st} Century Learning
- Mid to high levels of complexity
- Authentic learning focus
- Effective uses of contemporary technologies

The research team triangulated data from several sources in support of this finding. First, analysis was done of the survey data from teachers and administrators, the site visits, and the information from the points-of-contact and other educators at the Emerge events. The quantitative data indicate that schools have made progress with 21^{st} Century Skills and in shifting instructional approaches from didactic toward coaching and constructivist, which are more conducive to 21^{st} Century Learning. The data from the classroom observations and other aspects of the site visits support these findings.

21^{st} Century Skills. 21^{st} Century Skills are those skills beyond the academics deemed to be critical to today's students. At the inception of the program, the 20 Emerge jurisdictions used various lists and definitions of 21^{st} Century Learning including the enGauge 21^{st} Century Skills from Metiri Group and the North Central Regional Educational Laboratory (Figure 5), and the U.S.-based Partnership for 21^{st} Century Learning.

Each of the Emerge jurisdictions set individual goals and objectives for their program, thus each jurisdiction addressed different combinations of 21^{st} Century Skills. The point-of-contact in each jurisdiction indicated that the following percentages of jurisdictions were addressing the following skills:

Table 3: Percentage of jurisdictions addressing each of the identified 21^{st} Century Skills

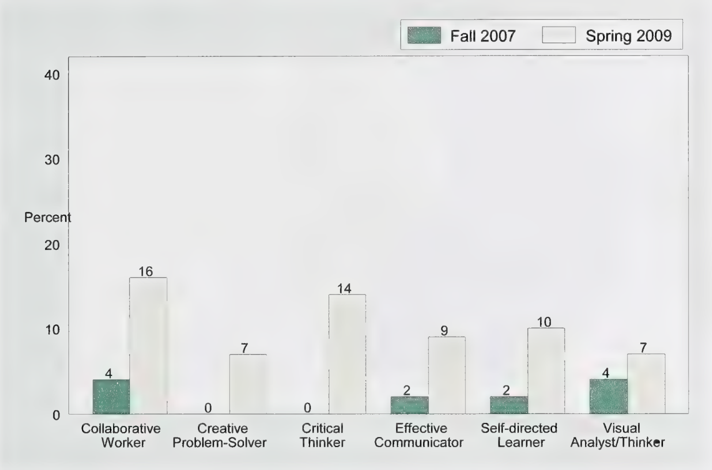
21^{st} Century Skill	Percentage of Jurisdictions Addressing the Skill
Information, Communication, and Technology (ICT)	100%
Critical Thinking	84%
Teaming and Collaboration	93%
Global Awareness	78%

Source: Point-of-contact survey (*n*=20)

Whereas in the first year of Emerge, the site reviewers reported few instances where teachers were addressing 21^{st} Century Learning, by the end of Year 2, the site reviewers were beginning to see increasing instances in classrooms where "substantial evidence" of 21^{st} Century Skill development was underway. In Spring 2009, the site reviewers visited 57 classrooms in 20 jurisdictions, noting substantial evidence of *Teaming and Collaboration, Critical Thinking,* and *Self-direction* in 16%, 14%, and 10% of classrooms respectively. (See Figure 6) Further disaggregation of the data by level indicates fairly consistent findings at Elementary and Secondary levels, of "substantial evidence." (See Table 4)

However, the number of instances where each skill was "somewhat" addressed was consistently higher in Elementary classrooms than in Secondary, with the exception of *Critical Thinking* and *Creative Problem-Solver* where two levels did not differ considerably. The reader is cautioned that these data represent a snapshot in time in these classrooms, in jurisdictions that may or may not be focusing on the listed skills. The importance of Figure 6 is in the increases over time, indicating that the integration of the skills into learning is on the rise.

Figure 6. Percentage of classrooms in Year 2 where "substantial evidence" was observed for each skill



Year 1. *N*=59 classrooms. Year 2. *N*=57 classrooms

Table 4. Percentage of classrooms visited in Spring 2009 in which select 21st Century Skills were observed by site reviewers

	Percentage of Elementary classrooms			Percentage of Secondary classrooms		
	Not at all	Somewhat	Substantially	Not at all	Somewhat	Substantially
Self-Direction	39%	36%	9%	44%	28%	12%
Collaboration	18%	39%	15%	28%	28%	16%
Communication	21%	52%	12%	44%	32%	4%
Critical Thinking	36%	33%	15%	40%	36%	12%

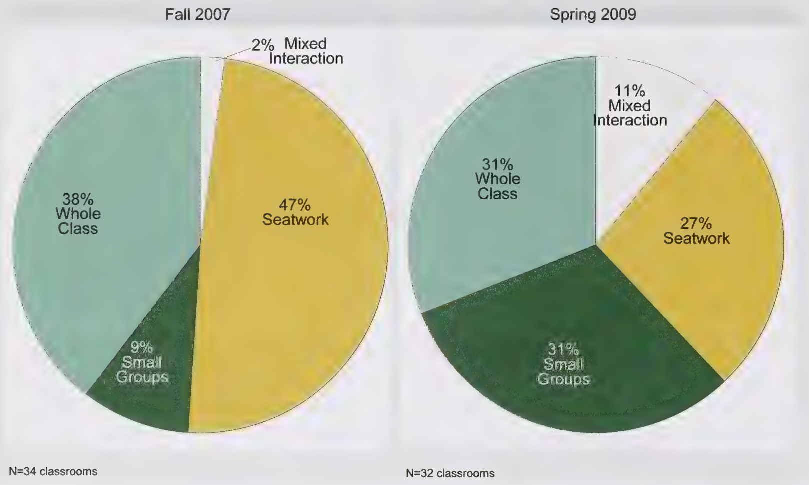
Elementary: *N*=32 classrooms. Secondary: *N*=25 classrooms

In summary, while the Emerge classrooms are only just beginning to address the 21st Century Skills, there were substantial increases in the number of classrooms that addressed at least one 21st Century Skill during the researchers' site visitations.

Student Groupings. The "student groupings" describe how students are grouped during classroom lessons. The researchers consider this important because certain types of groupings are strong indicators of instructional style. For example, large percentages of whole-group instruction suggest an orientation to didactic teaching, whereas small groups indicate the potential for collaborative student work. The researchers take a read of the groupings three times during each classroom observation and would expect to see a variety of groupings across multiple classroom observations within a school, a jurisdiction, and the province.

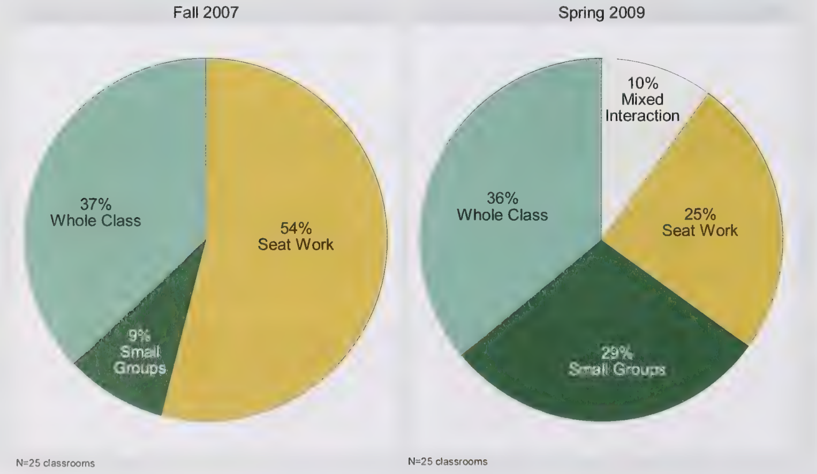
From Fall 2007 to Spring 2009, the percentage of students in the various types of student groupings within classrooms shifted significantly. In Elementary classrooms (Grades 3-5), whole class instruction decreased from 38% to 31%, and seatwork decreased from 47% to 27%. Meanwhile, small group work increased from 9% to 31% as shown in Figure 7.

Figure 7. Classroom Organization: Mean Percent of Time for Grade 3-5 Student Groupings



In Secondary classrooms (Grade 6-12), whole class instruction slightly decreased from 37% to 36%, and seatwork decreased significantly, from 54% to 25%, with small group work increasing from 9% to 29% as shown in Figure 8. The net effect of these changes provided increased opportunities for collaboration among students.

Figure 8. Classroom Organization: Mean Percent of Time for Grade 6-12 Student Groupings

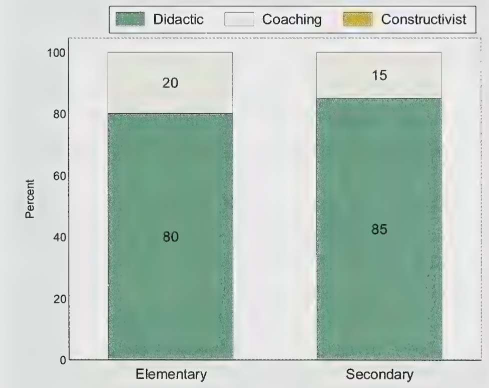


In summary, students in observed classrooms (all grades) in Fall 2007 were spending approximately a third of their time in whole class instruction, about half of their time in seatwork (some of which included interaction), and the remaining time (one-sixth of their time) in small groups. That changed in Spring 2009, with students in observed classrooms spending only a quarter of their time in seatwork, and nearly a third in small groups. This contributes to collaboration among students.

Instructional Strategies. One of the goals of most of the jurisdictions in the Emerge program is more student-centered learning. To accomplish this, instructional strategies need to include a measure of coaching and constructivist instructional approaches to learning. The researchers take a read of the instruction in each classroom at three points in time, recording the degree to which the instruction is didactic (e.g., whole class lecture or discussion), coaching (e.g., scaffolding student learning individually with students or in small groups), or constructivist (e.g., inquiry or problem-based learning).

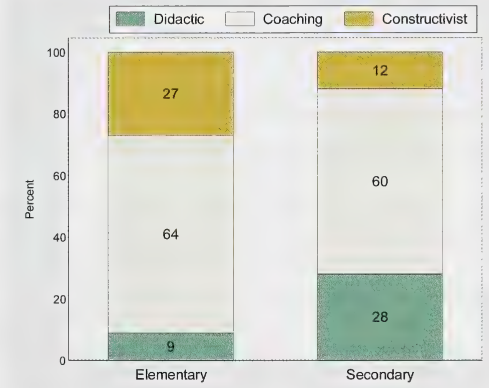
There was a positive shift toward a more balanced combination of instructional styles from Fall 2007 to Spring 2009. In Fall 2007, the observations revealed the most common instructional approaches to be didactic, with some degree of coaching evident for both Elementary and Secondary, but no constructivist learning. However, the classroom observations in Spring 2009 revealed shifts in practice toward greater emphases on coaching, with some constructivism beginning to emerge in both Elementary and Secondary levels. For example, in Fall 2007 for Elementary classrooms, 80% of the instruction was classified as didactic and 20% classified as coaching. Similarly, Secondary classrooms scored 85% didactic and 15% coaching. By Spring 2009 that had shifted at the Elementary level to 27% constructivist, 64% coaching and 9% didactic. Shifts in Secondary were also significant, to 28% didactic, 60% coaching and 12% constructivist.

Figure 9. Fall 2007: Observed Types of Instruction



N=59 classrooms

Figure 10. Spring 2009: Observed Types of Instruction



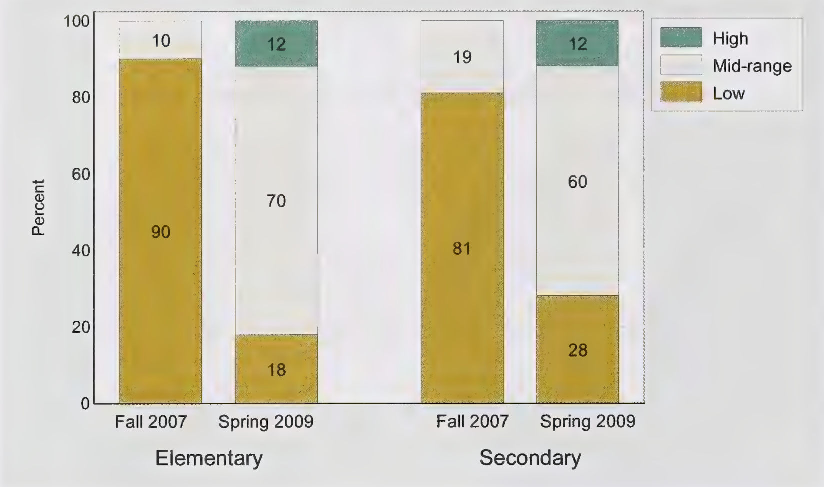
N=57 classrooms

Level of Complexity. Low levels of complexity map to lower order thinking skills and development of basic skills, whereas high levels of complexity represent higher order thinking skills/learning. The researchers take a read of the level of complexity of the lesson three times in each classroom observation. They record the complexity as low, mid-range, or high, taking into account the grade level of the students.

As shown in Figure 11, the level of *Complexity* observed in the Emerge classrooms increased significantly from Fall 2007 to Spring 2009 for both Elementary and Secondary levels. In Fall 2007, nearly all observed instruction were characterized by low levels of *Intellectual Complexity*. That shifted in

Spring 2009, with the majority of classrooms classified in the mid-range level of complexity, and 12% of both Elementary and Secondary classrooms classified as high *Intellectual Complexity*.

Figure 11. Observed Levels of Complexity by Time and Level



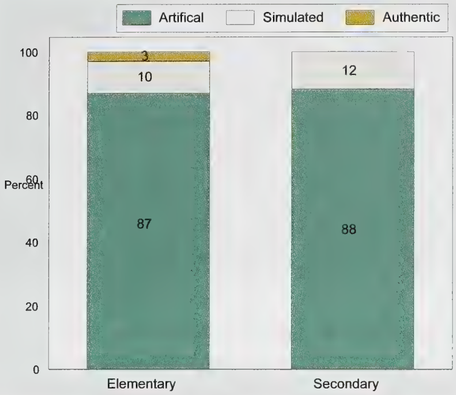
N=59 classrooms in Fall 2007; *N*=57 classrooms in Spring 2009

Authentic Learning. According to experts such as Dr. Fred Neumann, former professor at the University of Wisconsin, Madison, authentic learning includes three critical elements: deep inquiry of the content under study; relevancy of the student work to persons or entities beyond the school day; and students' demonstration of their learning through products. Due to the strong correlation between student engagement, learning with understanding, and academic achievement, the researchers documented the extent to which they observed authentic learning in Emerge classrooms. A low score in authentic learning was designated as Artificial (lacking real-world application), a mid-range score was designated as Simulated (imitating real world), and a high score noted as Authentic (modeling real-world applications).

Whereas in 2007 few classrooms were exhibiting authentic learning, by Spring 2009 the researchers did note higher number of instances of authentic learning in observed classrooms. (See Figure 12 and Figure 13). That shift paralleled a shift in instructional strategies toward constructivism. In Fall 2007, both Elementary and Secondary scores had 87% and 88% of the instruction being classified as Artificial and with 10% and 12% being identified as Simulated, respectively. Elementary in Fall 2007 and Spring 2008 did have 3% of the observations scored as meeting the criteria for Authenticity. The scores from Fall 2007 to Spring 2008 were similar for both groups.

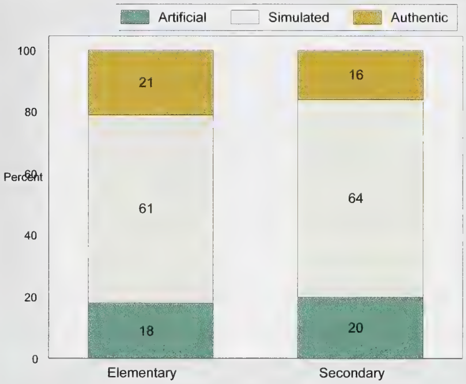
However, in Spring 2009 there was a substantial shift away from the Artificial end of the continuum and more toward Authenticity. For Elementary classroom observations, 18% were scored as being Artificial, 61% being Simulated and 21% as fostering Authenticity. In comparison, Secondary had a score of 20% being Artificial, 64% being Simulated and 16% fostering Authenticity. From the site visit data, it was evident that learning is being designed where students have a voice and are actively involved in creating and co-creating knowledge. Students in Emerge classrooms appear to be more engaged in higher order thinking, with a greater focus on deep knowledge, and in making connection to the world beyond the classroom. More sophisticated use of technology is being used to support real world tasks and fostering deep learning. Connections are being made to students' personal lives and connecting to others.

Figure 12. Fall 2007 Observed Authenticity



N=59 classrooms

Figure 13. Spring 2009 Observed Authenticity



N=57 classrooms

In summary, the significant shifts in classroom practices suggests that, Emerge teachers are changing their classroom practices to leverage 21st Century Learning through the laptops.

Student Engagement

Finding 1.3

Elementary-level Emerge students (grades 3-5) reported higher levels of engagement than Secondary-level students across years. Despite a slight decrease in the mean scores over time, on average, the engagement scores of Emerge students remained in the moderate to high range.

Are your students genuinely interested in the topics they are studying? Are they highly motivated and committed to learn? Do they persevere when challenged with complex topics? Are they achieving deep, authentic learning? Are they self-directed? Answering "yes" to these questions would suggest that your students are engaged learners.

The literature would suggest that, unfortunately, many teachers across North America are answering "no" to these questions. Increasingly, schools are finding that students feel alienated from their schools, perceiving them as boring or irrelevant to their lives. As a result, many students do just enough to get by, while the most disenfranchised simply drop out. These students are not being prepared to compete and excel in the 21st Century. Teachers' interest in engagement is often driven by the need to ameliorate low levels of academic performance, inappropriate classroom behaviors, and/or high numbers of dropouts. In fact, engagement is influential in all students' learning trajectories. Emergent research identifies student engagement in learning as one of the most powerful factors affecting achievement of students at every ability level.

What is engagement?

For the purposes of this work, student engagement is defined as, "the degree to which students are actively pursuing deep learning related to established standards." Deep learning is defined as "learning that involves the critical analysis of new ideas, linking them to already known concepts and principles, and leads to understanding and long-term retention of concepts so that they can be used for problem solving in unfamiliar contexts" (Houghton, 2004).

Levels of Student Engagement

The Student Engagement Survey, developed by Metiri, includes a series of questions aligned to the cognitive, behavioral, and social/emotional elements of the definition. Building off the research of recent engagement theorists, a taxonomy of student engagement levels was developed to distinguish different types of engagement as listed below.

- Intrinsically Engaged
- Tactical
- Compliant
- Withdrawn
- Defiant
- Indeterminate

Using this taxonomy, one would expect an engaged student to respond positively to "I like anything I learn about in school." Similarly, a withdrawn student would rate a high level of agreement with the statement "I do not go to school activities after school. I like to leave school as soon as I can." Nine survey items were written to reflect each of the 5 levels of engagement for a total of 45 items. The engagement level of students was established by locating the level with the highest mean across the 9 questions within that category. Students whose responses did not fit within the definition of one engagement level were classified as indeterminate. The types of engagement are defined in more detail below, followed by several graphs showing the percentage of students in each of the engagement levels at Time 1 and Time 2.

Characteristics of Intrinsically Engaged students

- Student sees the activity as personally meaningful.
- The student's level of interest is sufficiently high that he persists in the face of difficulty.
- The student finds the task sufficiently challenging that he believes he will accomplish something of worth by doing it.
- The student's emphasis is on optimum performance and on "getting it right."

Characteristics of Tactical students

- The official reason for the work is not the reason the student does the work, she substitutes her own goals for the goals of the work.
- The substituted goals are instrumental – grades, class rank, college acceptance, and parental approval.
- The focus is on what it takes to get the desired personal outcome rather than on the nature of the task itself –satisfactions are extrinsic.

Characteristics of Compliant students

- The work has no meaning to the student and is not connected to what does have meaning.
- There are no substitute goals for the student.
- The student seeks to avoid either confrontation or approbation.
- The emphasis is on minimums and exit requirements: “What do I have to do to get this over and get out?”

Characteristics of Withdrawn students

- The student is disengaged from current classroom activities and goals. The student is thinking about other things or is emotionally withdrawn from the action.
- The student rejects both the official goals and the official means of achieving the goals.
- The student feels unable to do what is being asked, or is uncertain about what is being asked.

Characteristics of Defiant students

- The student is disengaged from current classroom activities and goals.
- The student is actively engaged in another agenda.
- The student creates her own means and her own goals.
- The student’s rebellion is usually seen in acting out – and often in encouraging others to rebel.

Sample

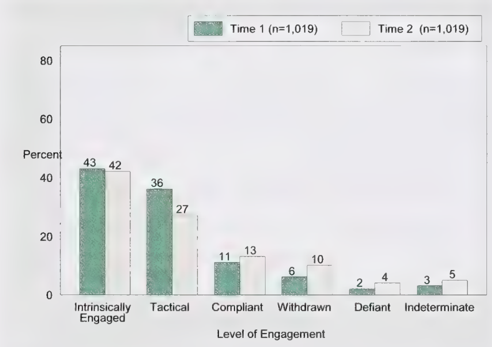
A total of 1,019 students took the Student Engagement Survey at both Time 1 (T1) and Time 2 (T2). (See Table 5). These trends only report student involvement during a mature year of Emerge (i.e., Year 2). That means that, for some students, their baseline is from Fall 2007, and for others it is Fall 2008. Additional information on the student data is available in Appendix B.

Table 5. Sample size for the Student Engagement Survey by Time

Time Point	Total Sample (*N*)	Matched Sample (*n*)
Time 1 (Fall 2007)	1,721	1019
Time 1 (Fall 2008)	652	
Time 2 (Spring 2009)	1,624	1019

The engagement scores of Emerge students in the aggregate are consistently moderate to high across the two years. As shown in Figure 14, the percentages of students in each level showed very little variation across time points, except for a 9% decrease in the percentage of students classified as *Tactical*. The majority of students were classified as *Intrinsically Engaged*, the highest of the five levels, at both Time 1 (43%) and Time 2 (42%). The percentage of students classified as *Defiant* slightly increased from 2% at Time 1 to 4% at Time 2, as did the percentage of students classified as *Withdrawn* (6% to 10%) and *Compliant* (11% to 13%). Metiri has noted in its prior work that, as students progress through the grades their engagement in learning typically decreases. Since these data represent trends over time, it would be expected that students' engagement scores would decrease slightly, as is indicated below.

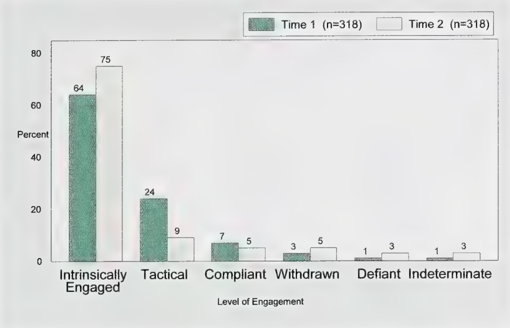
Figure 14. Percentage of all students in each engagement level



n=1019 Matched students

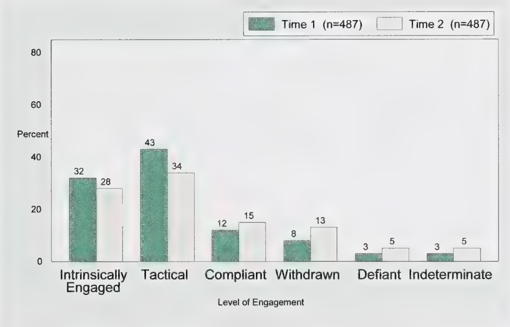
The following figures are broken down by instructional level to show further detail. As the following charts indicate, those students who remained at the Elementary level from T1 to T2 registered an increase in engagement. Meanwhile those who moved from Elementary to Secondary levels, or who remained at the Secondary level registered a slight decrease in engagement. As mentioned earlier, average engagement scores remained in the moderate to high ranges across the two years.

Figure 15. Percentage of Elementary-level students in each engagement level



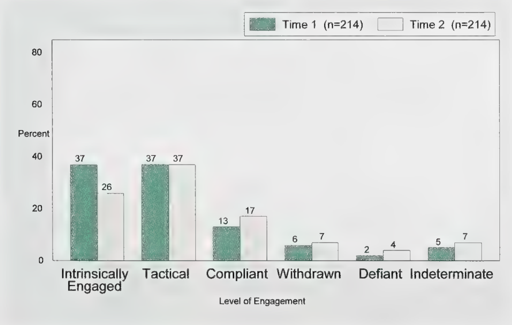
n=318 Matched students who remained Elementary from T1-T2

Figure 16. Percentage of Secondary-level students in each engagement level



n=496 Matched students who remained Secondary from T1-T2

Figure 17. Percentage of Level Switchers in each engagement level



n=214 Matched students who switch levels from T1-T2

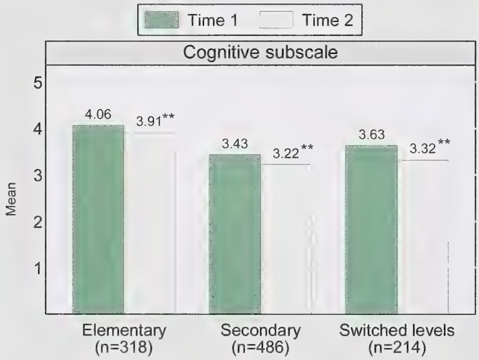
Experts in this field define engagement as having three overlapping dimensions: (1) cognitive, (2) behavioral, and (3) emotional (Fredricks, Blumenfeld, & Paris, 2004; Schlechty, 2002). While most schools focus on the cognitive aspects of the students' school experiences, less attention to date has been paid to the emotional and behavioral aspects – except to address negative aspects of the latter when they interfere with classroom and school functions.

While schools often look at how students respond to individual questions measuring different aspects of student engagement, it is essential and often more beneficial to look at the average of several items that ask about the same things in different ways. Accordingly, the following section reports scores on each of the three engagement constructs. Scores are reported on a 5-point scale with higher scores indicating higher levels of perceived engagement. In general, scores at or above 4.0 indicate that students perceive high levels of engagement at school. The scores on each of these constructs (also referred to as subscales) provide a more robust depiction of student engagement.

Cognitive engagement

Cognitive engagement refers to the degree of investment or effort put forth by the individual in the learning tasks encountered. It can be summed up as "thoughtfulness and willingness to exert the effort necessary to comprehend complex ideas and master difficult skills" (Fredricks et al., 2004). The mean scores for the *Cognitive* subscale displayed in Figure 18 show that the Elementary students aggregated scores at both time points surpassed both Secondary students' scores, as well as the students who were in grade 5 at Time 1 (Elementary-level), and grade 6 (Secondary-level) at Time 2 (herein referred to as "Level Switchers")[3]. Across all three groups, statistically significant differences were detected between the Time 1 and Time 2 scores, with Time 2 scores being lower as indicated by the asterisks in Figure 18. As noted above, this trend is typical as students progress through the grades. Since all groups average scores remained above three, the Emerge schools can generally be classified as engaged.

Figure 18. Mean scores on the Cognitive subscale by school level and time



NOTE: Asterisk (*) represents p < .05 level, (**) represents p < .01 level.

Emotional engagement

Emotional engagement refers to students' affective reactions in and to schooling. It may be registered as interest, boredom, anxiety, happiness, etc., but is generally thought to be a measure of the identification or belonging the student associates with schooling. The mean scores for the *Emotional* subscale are displayed in Figure 19.

Similar to the trend scores on the *Cognitive* subscale, all three groups also had significantly lower scores on the *Emotional* subscale at Time 2, compared to Time 1. However, the scores on the *Emotional* subscales were the highest of the three engagement constructs at both time points and for all groups.

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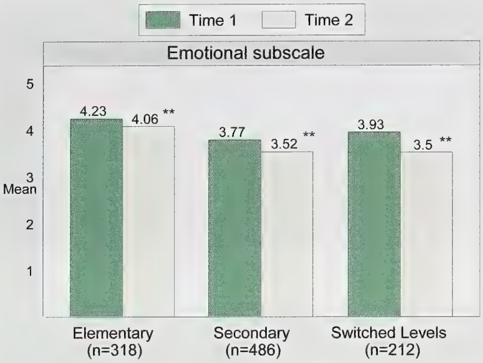
[3] For more detailed results of the paired *t*-tests throughout this report, please refer to tables in the Appendix.

Figure 19. Mean scores on the Emotional subscale by school level and time



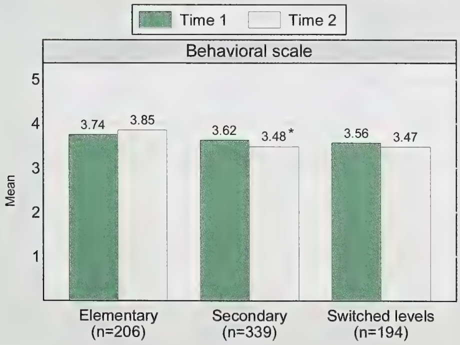
NOTE: Asterisk (*) represents p < .05 level, (**) represents p < .01 level.

Behavioral engagement (Participation)

Behavioral engagement focuses on participation. It is evidenced by the student's following of school rules, in class participation (e.g., academic and social), and extracurricular participation. Behavior is influenced by both cognitive engagement and emotional engagement.

Elementary students' scores on the *Behavioral* subscale increased from Time 1 to Time 2, albeit the difference was not statistically significant. The students who switched from Elementary to Secondary from Time 1 to Time 2 had slightly lower scores at Time 2, yet the difference was not statistically significant (as indicated by lack of an asterisk in Figure 20). Although the decrease in Secondary-level students' behavioral engagement from Time 1 to Time 2 score was statistically significant, the magnitude of this difference was relatively small (as shown in Figure 20). Again, the means for all three groups were above three (on a scale of 1-5), indicating moderate to high engagement.

Figure 20. Mean scores on the Behavioral subscale by school level and time



NOTE: An asterisk (*) indicates significance at the p < .05 level.

Self-Directed Learning Inventory (SLI)

A major goal of programs such as Emerge is for participating students to become self-directed learners. These skills are known to be important constructs in predicting the success of an individual on multiple types of tasks, including setting academic goals and performing well in school. Therefore, monitoring self-direction among students gives stakeholders an additional means to gauge the program's level of impact across years.

Finding 1.4

Emerge students had relatively high levels of self-direction across the first two years of Emerge. While the Emerge students registered a statistically significant decrease over time, the overall magnitude of the change was quite small.

What is self-directed learning?

Self-directed learners are generally described as motivated participants who efficiently control their own learning experiences. This includes organizing and rehearsing information to be learned, and holding positive beliefs about their personal capabilities, the value of learning, and the factors that influence learning. For example, a student who believes earning a high grade in a difficult science course is achievable and persists in his or her efforts is considered a self-directed learner. Many social learning theorists suggest that self-directed learning processes and accompanying beliefs fall into three cyclical phases: *Forethought*, *Performance/Volitional control*, and *Self-reflection*. These three phases of learning, as outlined by Schunk and Zimmerman (1998), are described in more detail below.

The *Forethought* phase refers to processes and beliefs that precede efforts to learn and establish the basis for learning. Examples of these processes include goal setting, planning, and numerous self-motivational beliefs such as self-efficacy and outcome expectations. The *Performance/Volitional control* phase refers to processes that help learners focus on the task and optimize their performance. Examples of these processes include self-control mechanisms (e.g., self-instruction, imagery, and attention focusing) and self-observation processes (e.g., self-recording one's behavior). The *Self-reflection* phase refers to processes associated with self-observations: self-judgment and self-reactions. An example would be answering the question: Did I improve my behavior or performance? These self-reflections, in turn, influence forethought regarding future efforts—thus completing the self-directed learning cycle.

Sample

As shown in Table 6, 761 students took the SLI in both Time 1 and Time 2.

Table 6. Sample size for the SLI by Time

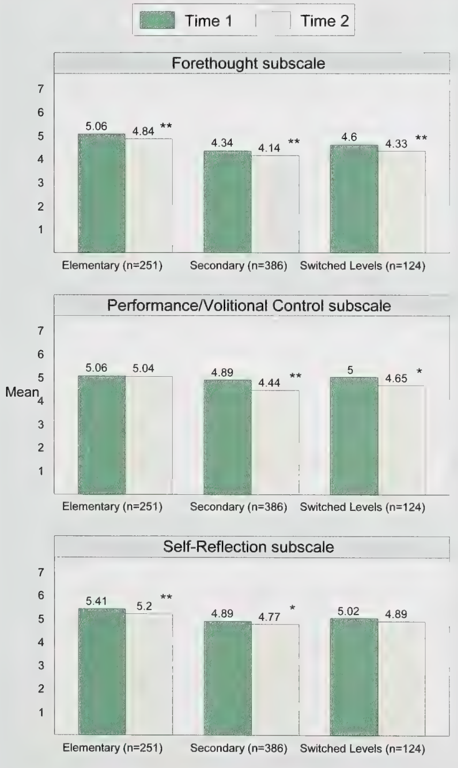
Time Point	Total Sample (*N*)	Matched Sample (*n*)
Time 1 (Fall 2007)	1,522	761
Time 1 (Fall 2008)	504	
Time 2 (Spring 2009)	1,445	761

Findings

Despite the drop in scores, all of the subscale scores shown in Figure 21 fell within the moderately self-directed range (i.e., 4.5-5.5), except for Secondary-level students' *Forethought* scores and *Performance/Volitional Control* Time 2 score. This suggests that, on average, Emerge students are moderately familiar with, and sometimes use, various self-directed learning strategies in order to prepare for a test or complete an assignment. Further visual inspection of the subscale scores for all three groups (Elementary, Secondary, and those who switched levels) in Figure 21 reveals that the *Forethought* subscale had the lowest average scores across groups and time points. All three groups' mean Time 2 *Forethought* scores represented a highly statistically significant decrease.

In order to see an increase in *Forethought* scores, teachers need to promote the use of goal setting and other forethought strategies. To do this, teachers must cultivate students' interest in the learning activities since it is evident that children's goal-setting behaviors are influenced by the perceived value of the task. When children find a particular achievement task interesting, important, or useful, they are more likely to set specific, challenging goals for their performance on the assignment.

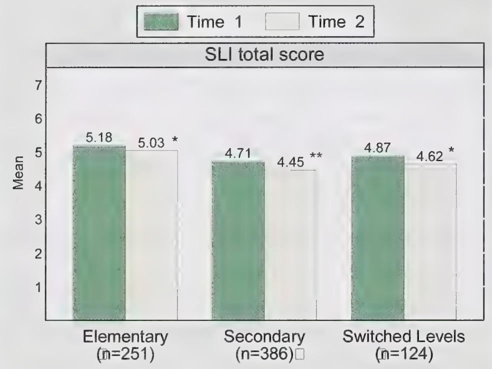
Figure 21. Mean scores on the SLI subscales by Time and Level



NOTE: Asterisk (*) represents p < .05 level, (**) represents p < .01 level.

Each of the three subscales shown in Figure 21 contributes an equal share to the overall SLI score. The mean scores for the *overall SLI* construct are shown in Figure 22.[4]

Figure 22. SLI total score by time



NOTE: Asterisk (*) represents p < .05 level, (**) represents p < .01 level.

Another way to look at the SLI scores includes grouping each student into the four levels of self-direction (*High*, *Moderate*, *Low*, and *None*).

Figure 23 shows the percentages of students within each level of self-direction disaggregated by grade level designation during their Emerge experience. Less than 2% of the matched sample fell within the *None* level for both Time 1 and Time 2. The percentage of students in the *Low* level, however, increased from 5.8% to 11.8%, whereas the percentage in the *Moderate* level decreased from 34% to 28.1%. The percentage of students in the *High* level remained stable at about 10% across time points.

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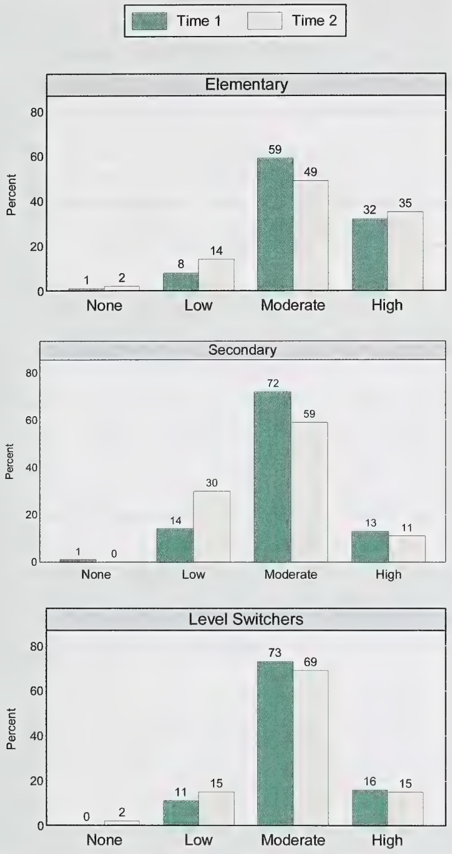
[4] Additional information, including the results of the paired sample *t*-tests comparing Time 1 and Time 2 scores for the SLI subscales, is included in the Appendix.

Figure 23. Percentage of students within each level of self-direction ranging from None to High: Time 1 and Time 2



The Emerge program saw a spike in engagement scores in Year 1 and then a slight decline in Year 2. The researchers suggest that this dip many represent what some in education refer to as the implementation dip, where the new classroom structures are in place, but teachers are not yet expert in the implementation of such structures. For students in Emerge, the “bloom is off the rose,” with regard to the novelty of the laptop and they, too, are experiencing a change in role and responsibility that is not yet quite comfortable. It is at this time that that the program is the most difficult to sustain and grow. However, those who do are typically rewarded as they push through the mid-term barriers to complete the cycle of change in reaching a maturity of the program that enables sustainability of high-quality programs.

Recommendations Related to Question 1:
What are the potential educational benefits of one-to-one laptop learning?

Recommendation 1a: Jurisdictions should continue to mature and scale student-centered, inquiry-based approaches to learning.

Recommendation 1b: Emerge educators should support and scaffold self-direction and other 21st Century Skills in students.

Recommendation 1c: Alberta Education should provide clear definitions for student engagement in deep learning, and identify research-based strategies to increase all facets of student engagement (i.e., cognitive, socio-emotional, and behavioral). Emerge educators should build 21st Century Learning environments that use research-based practices to deeply engage students in learning, especially in support of students who are under-performing academically.

Recommendation 1d: Albert Education should clearly define 21st Century Skills for the province and should integrate such skills into the provincial curricula.

Recommendation 1e. Alberta Education should provide leadership in the assessment of 21st Century Learning, explicitly addressing the alignment with the content areas.

Question 2: Technical Merits and Innovative Practices

What are the technical merits and innovative practices in one-to-one wireless learning?

The Emerge jurisdictions and schools spent the first year focused on purchasing and deploying laptops and wireless networks in their schools. By the end of the first year, those networks were established and their attention turned to technical support and maintenance. In some jurisdictions that continued support was interrupted due to the jurisdictions bringing on additional networks and technologies that, although unrelated to the Emerge program, drew on the technical support system for the jurisdiction. In others, the technical support remained at the level originally established for Emerge.

Wireless Networks

Wireless networks have been established by the Emerge programs that are, in general, adequately meeting the basic requirements of most Emerge one-to-one programs. The first year of the Emerge program was largely focused on the purchase and deployment of wireless networks, laptops, and associated peripherals. (Dimension 6: Access and Infrastructure, page 53)

Finding 2.1

Wireless networks have been established by the Emerge programs that are, in general, adequately meeting the basic requirements of most Emerge one-to-one programs.

Technical Support

Now, in the second year of the program the feedback from teachers indicates that the level of technical support varies across the jurisdictions. Nearly 25% of teachers still, at this point in the program, say it is a barrier to success.

Some jurisdictions have dedicated staff assigned to the program, whereas other jurisdictions have incorporated the Emerge support into their overall district support. Within the Emerge program, the learning process is highly dependent on student access of high-speed bandwidth and operational laptops. When technical problems arise that are queued within the district's technical support system, rather than attended to as priorities, the learning program is disrupted.

Finding 2.2

The level of technical support varies across the jurisdictions. Some jurisdictions have dedicated staff assigned to the program, whereas other jurisdictions have incorporated the Emerge support into their overall district support.

Sustainability

Finding 2.3

Emerge programs are actively exploring options for sustainability beyond the grant period.

One of the challenges in every grant program is the sustainability of the curricular interventions launched during the grant award period. Emerge is no exception. Alberta Education conceptualized Emerge as a research program intended to investigate the efficacy of one-to-one laptop learning. Alberta Education made it clear from the inception of the program that there was an expectation that, after the third and final year of the program, the jurisdictions would be expected to have identified best practices and have developed and begun implementation of a plan for sustainability of such practices launched during Emerge.

Now at the end of the second year, Emerge programs are actively exploring **options for sustainability of the technical aspects of Emerge** beyond the grant period. As early as this second year, Emerge programs are beginning to experience some equipment failure (i.e., laptops, battery life, etc.), even as they are looking to expand their laptop program to more classrooms. For some schools this is taking the direction of innovative practices to support student-owned devices within the school environment. Emerge educators have noted the increased number of students who own devices and the need for a financial model that supports scaling one-to-one to all students. This is evidenced by several examples of Emerge programs that have already scaled the program beyond the initial classrooms (in part due to the pressure by parents to continue laptop access for their children beyond the scope of Emerge).

Recommendations Related to Research Question 2: What are the technical merits and innovative practices in one-to-one wireless learning?

Recommendation 2a:

Emerge programs should be considering how to sustain, support, maintain, and grow the technologies and associated peripherals, technical assistance, and supplies and materials for the Emerge classrooms beyond the grant period.

Recommendation 2b:

Innovative models of students' ubiquitous access to technology under discussion within the Emerge program should be documented and shared, along with analyses of pros and cons to each model.

Question 3: Lessons Learned from Emerge

What expertise, experience, and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?

The Emerge program presented a steep learning curve for many students, teachers, and administrators, on three fronts: the technological, the organizational, and the pedagogical. The first year of the program was focused on the purchase and deployment of technology; building and scaffolding the technical knowledge and expertise of teachers and students; and establishing new classroom management procedures and, to some degree, new instructional approaches to facilitate learning.

An added degree of complexity was added by some jurisdictions decisions to have the laptops follow the students from grade to grade, resulting, in most cases, in different teachers teaching the students in Year 2 of the program. That meant some Emerge teachers stayed with the program—i.e., they moved to the next grade with their students, or the laptops stayed at their grade level and did not stay with the students. These teachers had acquired some expertise, and technological knowledge and skills, and were now concentrating on the new designs for learning enabled through technology. Other teachers were new to the program, and now at the beginning stages of the technological learning curve, and were teaching students often more experienced technologically than they were.

As a result, Emerge teachers and students are at different levels, yet making steady progress in developing the fluency, expertise, and knowledge base necessary to use the technology to advance learning. The following findings represent the status at the end of Year 2. The recommendations are presented by the researchers for consideration by Alberta Education and the Emerge jurisdictions.

Educator Fluency with Technology Precedes Effective Use

The Emerge educators (teachers and administrators) have made steady progress in their proficiency with technology and 21st Century Learning. There seems to be a natural progression in such learning that necessitates the teachers' acquisition of technology fluency prior to effective uses for learning.

Finding 3.1

The Emerge educators (teachers and administrators) have made steady progress in their proficiency with technology and 21st Century Learning.

Administrative Support is Generally Supportive

School administrators are showing increased appreciation and support for the accomplishments of the Emerge classrooms. Some of the Emerge programs, when faced with the difficult decision of deciding that the laptops follow the students or the laptops stay at grade level with a teacher, chose to buy a new set of laptops, which enabled them to do both. This was due in part to parental and community influence.

Finding 3.2

School administrators are showing increased appreciation and support for the accomplishments of the Emerge classrooms.

Professional Development Programs

The Emerge programs include a range of professional development models. Those include: job-embedded professional development, online and face-to-face communities of practice, and in school coaching and mentoring.

Finding 3.3

The Emerge programs include a range of professional development models.

Rubrics are the Current Assessment of Choice for 21st Century Learning

The primary assessment of 21st Century Skills and Learning in the Emerge program is achieved by the use of rubrics (e.g., for students' digital projects, authenticity, engagement, critical thinking, collaboration, etc.).

Finding 3.4

The primary assessment of 21st Century Skills and Learning in the Emerge program is achieved by the use of rubrics (e.g., for students' digital projects, authenticity, engagement, critical thinking, collaboration, etc.).

Trends May Evolve into Lessons Learned

A number of preliminary trends may evolve into lessons learned during year 3. Those will be monitored and a complete list of lessons learned will be finalized in the final report after Year 3 is completed.

In the interim, current observations indicate that the Emerge program is maturing as follows:

- Administrative support and ongoing involvement of school and district administrators is critical to the sustainability of the initiative.
- One of the driving forces for sustainability and scaling up of the successful aspects of the program is parental and community support.
- Teachers need to experience and internalize 21st Century Learning if they are to transform their classrooms into 21st Century Learning Environments.
- The transformation of a classroom from traditional teaching to 21st Century Learning happens incrementally, at a number of levels, and requires time to mature.
- The Emerge programs include a range of professional development models including: job-embedded professional development, online and face-to-face communities of practice, and in school coaching and mentoring.
- The capacity building (i.e., communities of practice, formative assessment reports, professional development, technical support, facilitation of discussions among technology directors and curriculum directors, etc.) throughout Years 1-2 seems to have been a factor in the progress accomplished by Emerge.
- Key to the progress of the Emerge one-to-one laptop implementation was the collaborative problem solving among curriculum, instruction, and technology professionals in order to tackle key issues and challenges.

Recommendations Related to Question 3:
What expertise, experience, and lessons learned have come from Emerge?

Recommendation 3a:

Now that models of one-to-one laptop learning are emerging (e.g., combinations of technologies, policies on home/school use, student-owned devices in schools, etc.), innovative leadership programs should be developed that build the capacity of teachers, administrators, and policymakers to select, support and scale such models.

Recommendation 3b:

As the Emerge 21st Century learning programs mature, models of innovative classrooms and schools, and professional development (e.g., embedded, coaching, mentoring, just-in-time, etc.) should be documented, shared, and expanded.

Recommendation 3c:

The 20 jurisdictional Emerge programs should be requested to report information, where appropriate, on the impact of the one-to-one laptop program with special needs populations.

Question 4: Readiness for 21st Century Learning/Technology

What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?

Discussion.

> **Finding 4.1**
>
> *The Emerge jurisdictions made progress on six of the seven dimensions of readiness for 21st Century Learning.*

The readiness of the jurisdictions to implement laptop learning effectively is dependent on each jurisdiction's capacity to attend to each of seven Dimensions established by the Metiri Group: Forward Looking, Shared Vision; Systems Thinking; 21st Century Skills and Learning Approaches; 21st Century Learning Environment; Teacher Proficiency with a 21st Century Environment; Access and Infrastructure; and Accountability/Results.

Because each of these Dimensions is interdependent, a systemic approach often results in a multiplier effect. This can mean that although a school or district may see incremental growth in the indicators – which means they are making progress – they may not realize full results with students until all indicators reach higher levels.

Based on surveys of Emerge teachers and administrators, a readiness score of 1-8 is determined for each dimension. Metiri further defines readiness through four stages of awareness, exploration, scaling up, and finally the systemic, described in Table 7 below.

Table 7: Interpreting the levels and stages of progress toward 21st Century Learning.

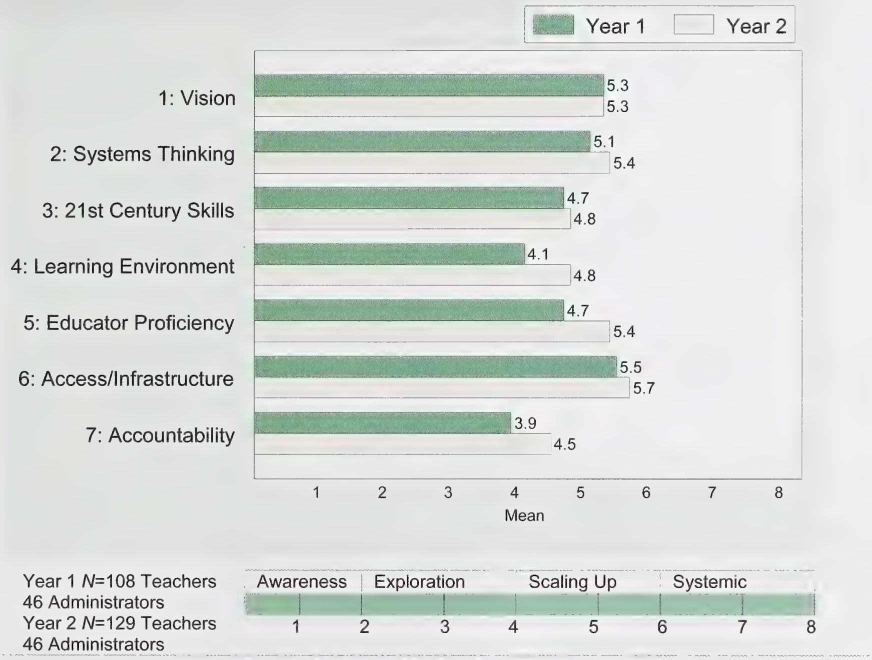
Awareness		**Exploration**		**Scaling Up**		**Systemic**	
At the awareness level stakeholders are cognizant of the importance of 21st Century Learning, and are interested and in the process of getting fully informed.		At the exploration level stakeholders are actively investigating opportunities and challenges related to 21st Century Learning (e.g., pilots, models, or work of pioneering teachers), but full commitments are being withheld until the concepts can be fully investigated.		At the scaling up level, stakeholders have made the decision to advance 21st Century Learning and are currently building the capacity of the system to change and transform accordingly.		At the systemic level it is evident that the innovation of 21st Century Learning has "tipped," and is deeply transforming teaching, learning, and leadership across the school system.	
0 1	2	3	4	5	6	7	8
At **level 1** the district is beginning the background reviews, reading, and discussions.	At **level 2** stakeholders are sufficiently informed to understand and consider the implications, but have not yet embraced the ideas.	At **level 3** the stakeholders are at the initial stages of serious investigation into what 21C means for their schools and community.	At **level 4** some stakeholders have become convinced (often through research or pilots) to advance 21st Century Learning, and have begun some preliminary capacity building, but the idea is not yet universally accepted.	At **level 5** leaders have formally made the commitment to embrace 21C, and are in the capacity building process that is necessary for advancing the innovation.	At **level 6** stakeholders have built the knowledge, expertise, and system capacity to shift to 21C. While some classrooms, departments, and levels have begun to transform, others have yet to make the shift.	At **level 7** most stakeholders are not only committed to the change, they have embraced and implemented components of 21C. They now have the tools to measure progress, and are on notice that they will be held accountable for 21C in the near future.	At **level 8** almost 100% of stakeholders embrace 21C, and are, through a community of practice, collaboratively transforming their practices to align to the principles of 21C. Staff and students are jointly accountable for the results.

In addition, the research team conducts site visits in order to provide context to the survey data. Those site visits included principal interviews, teacher focus groups, student focus groups, and classroom observations.

The Emerge jurisdictions made progress on six of the seven dimensions of readiness for 21st Century Learning. The overall trend data for Years 1-2 for the 7 Dimensions of readiness indicate that, provincially, the Emerge jurisdictions have made progress on all indicators, except Forward Looking, Shared Vision, which, taken together, has remained consistent across the two years. See

Figure 24.

Figure 24. Trend data for Emerge on 7 Dimensions of readiness for 21st Century Learning



Year 1 *N*=108 Teachers
46 Administrators
Year 2 *N*=129 Teachers
46 Administrators

At the baseline, the two Dimensions in which Emerge scored the lowest were *Accountability*, which was at the Exploration stage (3.9), and *21st Century Learning Environment* which was at the lowest level of the Scaling Up stage *(4.1)*. In Year 2, Emerge scores in both of those areas are now solidly in the Scaling Up stage (i.e., the jurisdiction understands the issue related to that Dimension, has some promising models in place, and is now working on expanding or scaling those models across grade levels, subject areas, and for all student populations). Note: Typically, Dimension 4, the *21st Century Learning Environment*, is the last to shift, since it is so dependent on the other Dimensions being in place.

Each of the Dimensions is discussed in more depth below. The following set of findings represent the provincial readiness of the Emerge jurisdictions for 21st Century Learning and effective uses of technology in learning at the end of Year 2. The recommendations at the end of this section are offered for consideration by Alberta Education and the Emerge jurisdictions.

Dimension 1: Forward Looking, Shared Vision

Discussion

Finding 4.2

The Emerge teachers now – in Year 2 – have a deeper understanding of and commitment to the vision for 21st Century Learning in their respective Emerge projects.

Vision matters. A forward-thinking, shared vision serves as a unifying and energizing force of change within a school system. It serves as a vehicle for setting targets that align to all curriculum, instruction, assessment, scheduling, progress reporting, and community communications. Each of the 20 Emerge jurisdictions established their own unique vision and goals related to academics, 21st Century Learning, and special populations. While the aggregate score for *Forward Looking, Shared Vision* remained at 5.3 across the two years, the teachers and administrators perspectives shifted considerably, the teachers from 5.2 to 5.9 and the administrators from 5.3 to 5.0. The site visits verified this, in that, in the first year it was clear from the site visits that these goals, especially related to the impact of the laptops on 21st Century Skills, was not uniformly understood, or committed to, by all teachers. This second year, some jurisdictions have revisited their visions to give greater focus to their work. In most cases, the vision this second year is much more clearly understood by the teachers in terms of how it translates into classroom practice.

The data from the teacher and administrator surveys in Spring 2009 established the Emerge initiative provincially in the Scaling Up stage for Dimension 1 (5.3 on an 8-point scale, the same score as at baseline in Fall 2007).

Spring 2009 Stage of Readiness: Forward Looking, Shared Vision

Awareness	*Exploration*	*Scaling Up*	*Systemic*
Educators are only now building awareness of what 21st Century Learning is and why it is important. Even those efforts are often fragmented.	The district or school leaders are actively investigating, discussing, and debating the issue of 21st Century Learning and educational technology. Educators may be attending conferences, taking classes, visiting pioneering districts, and building a knowledge base that is informed by research. At this stage leaders would be reaching out to the community, parents, businesses, industry, and students to join the discussions.	At this stage, a vision for 21st Century Learning and educational technology is emerging in pockets across the district or within the school. Some departments, grade levels, or even schools have collectively established a forward thinking vision, and leaders within the district are building on that work to draw all sectors into a collective vision.	There is a forward-thinking vision in place for 21st Century Learning. That vision was collaboratively developed, widely communicated, and is grounded in educational research. Educators at all levels, the community, and other stakeholders are fully committed to the vision.

5.3 (remained consistent from Fall 2007)

The Emerge scores on *Forward Looking, Shared Vision* have remained consistent over the 2-year implementation, yet there are some marked differences in administrator and teacher scores. While administrators' scores on *Forward Looking, Shared Vision* declined slightly (from 5.3 to 5.0) they remained in the Scaling Up area. Teachers' scores, however, showed a marked increase (from 5.2 to 5.9), indicating that after their experience with Emerge, they are clearly seeing and committing to a *Forward Looking, Shared Vision* for 21st Century Learning. There was a marked increase in the percentage of teachers who reported they were "extremely supportive" of the Vision for 21st Century Learning from Fall 2007 (54%) to Spring 2009 (60%). Teachers also reported an increase in the emphasis their school or jurisdiction had on the 21st Century Skills that were included in their jurisdiction's Vision. While Digital

Literacy and Lifelong Learning remained the top emphases by schools and jurisdictions, the three that registered the largest increases in emphasis were: Citizenship in a Changing, Global Society (+0.7), Community Connections (+0.6) and Cultural Diversity (+0.6), all on an 8-point scale.

It seems that administrators were fairly comfortable with the initial vision the jurisdiction included in its proposal to Alberta Education, which resulted in the Emerge grant award to their district. However, teachers only became sufficiently familiar in the second year with what that vision meant in their classrooms, and that is when they began to fully commit to their jurisdiction's Emerge vision.

Dimension 2: Systems Thinking

Discussion

Systems Thinking is defined here as policymaking and practice implementation that acknowledges and accounts for the interrelationships among all parts of the system in achieving effectiveness and efficiencies.

Finding 4.3

The Emerge leaders have maintained the depth and breadth of their support for Emerge one-to-one laptop learning throughout the program.

The Emerge teachers and administrators survey responses in Spring 2009 placed Emerge in the *Scaling Up* stage of readiness (5.4 on an 8-point scale, as compared to the baseline score of 5.1 in Fall 2007).

Spring 2009 Stage of Readiness: Systems Thinking

Awareness	*Exploration*	*Scaling Up*	*Systemic*
At this stage, the thinking and planning in the district or school for 21st Century Learning is very ad hoc, typically by individual educators or with certain programs.	A few educators and some leaders are taking the long-view, thinking deeply about where the key leverage points are in the system that will positively shift teaching and learning in ways that fully prepare students for the 21st Century. In fact, some are exploring ways various new approaches can be used, and are working hard to ensure that all stakeholders are not only ready for such change but also are eager and excited about it. They are starting with some key schools and classrooms, modeling new cultures of learning that empower teachers and students.	The leadership team as a whole is committed to, and is taking responsibility for, systematically advancing toward 21st Century Learning. They have identified the new policies and practices required to achieve the vision, are scaffolding teachers into 21C, are setting high expectations for shifts toward 21C, and are creating the professional communities of practice as support structures critically necessary for change. While not yet fully aligned, all elements of the system are encouraged, empowered, and expected to make changes.	Leaders are using the district vision for 21st Century Learning as a design element in policy development, setting of standards, and prioritizing investments. They have set high expectations and definite timelines for implementation of 21st Century Learning. As a result curriculum, instruction, assessment, professional development, and accountability are aligned to that vision. There is a culture of creativity and innovation grounded in research that ensures the district will stay current.

5.4 (an increase from 5.1 in Fall 2007)

The researchers looked across the projects and found that the implementation of Emerge varied greatly across jurisdictions, across schools within jurisdictions, and across classrooms within the schools. The idiosyncratic nature of the current implementation is confirmed in noting the percentage of teachers who answered the question about systemic implementation (see Table 8). Only 22% of teachers in Fall 2007 and 20% in Spring 2008 indicated that there was a systemic approach that would ensure that all students would be assured of a consistent approach to 21st Century Learning and technology, regardless of classroom assignments and students' schedules.

Table 8: Systemic aspects of implementation of classroom practices: Teachers were asked: In my school teachers in the same grade or subject areas:

	Year 1	*Year 2*
Share little or no common understanding about evidence-based practices. Teachers decide individually whether and how they will make instructional decisions.	13%	16%
Share some common understanding about evidence-based practices; however, some teachers implement these uses and others do not.	61%	63%
Share a common understanding about evidence-based practices; there are clear expectations that such practices will be used.	22%	20%

NOTE: The practices indicated in this question provide insights into whether schools are systematically adopting evidence-based practices or are leaving such adoption to individual teacher choice.
Year 1. *N*=108 teachers. Year 2. *N*=129 teachers.

The percentage of teachers who said that they are "sometimes or always" provided the resources and support to redesign classrooms into 21st Century learning environments has stayed strong, slightly increasing from 73% in Fall 2007 to 78% in Spring 2009. One of the ways such support manifests itself is in the nature of the professional development provided Emerge teachers. Teachers indicated that the quality of such professional development has increased overall, but especially in three areas identified in Table 9, enabling them to see and plan with colleagues for educational technology and 21st Century Learning in their classrooms. Many of the Emerge projects narrowed their focus at the beginning of Year 2 to enabled them to address in depth a few 21st Century Skills. That resulted in more targeted professional development and more explicit work in the classroom to address this reasonable set of 21st Century Skills.

Table 9: Percentage of teachers saying this attribute is "always" evident in professional development provided by their school or jurisdiction

Attribute of professional development	*Fall 2007*	*Spring 2009*	*Difference*
Inclusion of opportunities for teachers to see actual *examples of technology* applied to learning in classrooms similar to theirs.	8%	30%	+22%
Inclusion of opportunities for teachers to see actual *examples of 21st Century Skills* applied to learning in classrooms similar to theirs.	6%	19%	+13%
Provision of *time for teachers to work together*, and to discuss and plan for using technology in the classroom.	12%	25%	+13%

Year 1. *N* = 108 teachers. Year 2. *N* = 129 teachers.

A key aspect of systems thinking is the enactment of policies supportive of the vision. One of the key indicators of such policies is the Acceptable Use Policy for the laptops. Given the work with Web 2.0 tools and exploring the opportunity for student-owned devices, school jurisdictions are exploring and/or developing policies and establishing practice. This is a potential growth area for the jurisdictions as they consider the implications for 24-hour-per-day, 7-days-a-week use by students in the school, home, and community.

Dimension 3: 21st Century Skills and Instructional Approaches

Discussion

As the Partnership for 21st Century Skills[5] so eloquently states, *"To successfully face rigorous higher education coursework, career challenges and a globally competitive workforce...schools must align classroom environments with real world environments by infusing 21st century skills into their teaching and learning."*

In Year 2, most jurisdictions realized the impossibility of addressing all of the twenty-plus 21st Century Skills and adopted a "less is more" philosophy, focusing on only a few skills. By narrowing the focus to a few 21st Century Skills, educators have been able to drill down and deepen learning about a few skills, rather than superficially addressing all.

Finding 4.4

Over the course of the first two years of Emerge, the perception of teachers as to the relevance of the 21st Century Skills to content has shifted from highly valuing productivity and communication to more highly valuing the use of tools in critical thinking, creativity, and ethical use.

The educators' survey responses in Spring 2009 placed Emerge in the Scaling Up stage of readiness for Dimension 3 (4.8, with the baseline score at 4.7).

Spring 2009 Stage of Readiness: 21st Century Skills and Instructional Approaches

Awareness	*Exploration*	*Scaling Up*	*Systemic*
While educators are aware of the concept of 21st Century Skills and Learning, there are still significant misconceptions as to what truly constitutes 21st Century Skills, and little knowledge of the types of teaching and learning activities that are likely to promote these skills.	Leaders in the system who are advocating for 21st Century Skills have some familiarity with the cognitive science supporting 21st Century Skills and the types of practice that are likely to build these skills. This understanding is being communicated to some educators in the system who may be implementing portions of that practice, but these implementations are "pilots" and not widespread.	Formal processes for disseminating information and building 21st Century teaching and learning practices are being established. Professional development is being designed, piloted and refined. Most teachers are building skill in promoting 21st Century Skills and Learning.	In virtually every classroom, significant purposeful effort is being made to promote 21st Century Skills and Learning for all students. 21st Century Skills have been integrated into all curricula as appropriate and rich, and authentic learning is a core characteristic of virtually all instruction.

4.8 (an increase from 4.7 in Fall 2007)

The skills that teachers identified as most relevant to the content in Spring 2009 differed considerably from those considered most relevant in Fall 2007. As indicated in Table 10 whereas the top priorities in Fall 2007 were focused on the use of the tools for productivity, by the end of Year 2, teachers' priorities had shifted to the students' uses of the tools to think, create, and responsibly and ethically contribute.

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[5] The Partnership for 21st Century Skills is a U.S. based advocacy organization focused on infusing 21st century skills into education. http://www.21stcenturyskills.org/.

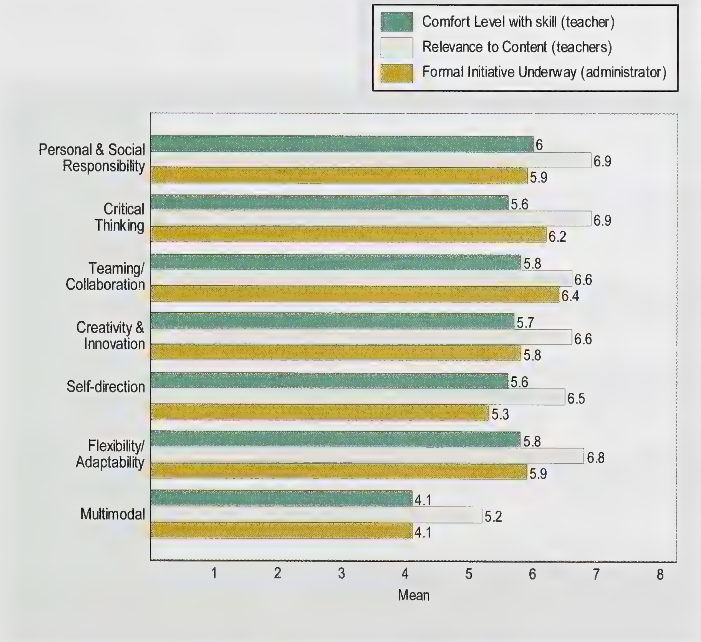
Table 10. Top five 21st Century Skills identified by teachers as most relevant to content

21st Century Skill	*Fall 2007*	*Spring 2009*
Personal and Social Responsibility		1
Critical Thinking		2
Flexibility/Adaptability		3
Creativity & Innovation		4
Teaming/Collaboration	1	5
Productivity	2	
Interactive Communication	3	
Effective Use of Real-World Tools	4	
Prioritizing, Planning, & Managing for Results	5	

Year 1. *N* = 108 teachers. Year 2. *N* = 129 teachers.

A review was done of the data on the top teacher priorities based on relevance of the 21st Century Skills to content. It reveals that both the teachers' comfort levels, and the administrators' reports on the extent to which formal initiatives on the skills are underway, lag behind the levels of relevance. The gap between the teachers' comfort levels and their perceptions of relevance of these skills to their content is greatest for *Critical Thinking* (1.3), *Flexibility and Adaptability* (1.0), and *Multimodal Learning* (1.1).

Figure 25. Teacher and administrator responses regarding 21st Century Skills



N=129 teachers and 46 administrators

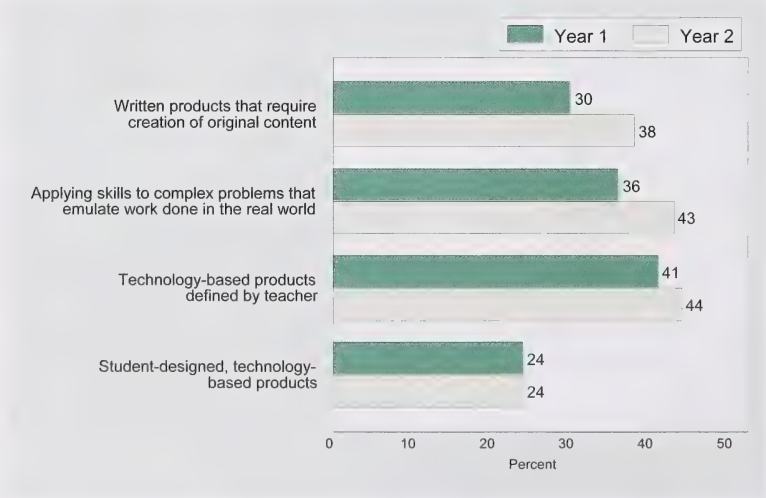
It is not expected that every lesson would address every 21st Century Skill. Rather, the school should be looking for a balance across classrooms. Within each lesson, eight 21st Century Skills are assessed in relation to the following: This skill could not be included in the lesson (N/A); the skill could be included in the lesson; the skill was promoted by the classroom environment; explicit instruction occurred and/or promoted the skill by the content selected for the lesson. If the skill could be included but was not, it was scored as Not at all. If the skill was included then it was scored in terms of One instance, Somewhat evident, or Substantially evident.

In Fall 2007, the three top skills that scored as being *Evident (Somewhat* or *Substantially)* in the lessons were *Self-directed Learning, Problem Solving*, and *Information and Technology Literacy*. In Spring 2008, both *Self-directed Learning* and *Information and Technology Literacy* were two of the three highest rated in terms of being *Evident (Somewhat* or *Substantially)* in classrooms, with *Teaming and Collaboration* being the third highest score. In Spring 2009, *Collaboration and Teaming, Critical Thinking* and *Effective Communicator* were in the top three scores. It is evident over the three reporting periods that the teachers' emphases on various 21st Century Skills is somewhat fluid. However, there are still a large percentage of these skills that are not being observed as either being promoted within the learning environment, through explicit instruction or within the selected content.

Additional indicators of 21st Century Skill attainment reside in the type and quality of student work. Two key factors that influence the quality of student work are student choice and student creativity. The following charts indicate that, while teachers report slight increases in these areas, administrators have not noted such changes in Emerge classrooms over the two years. (See Figure 26 and

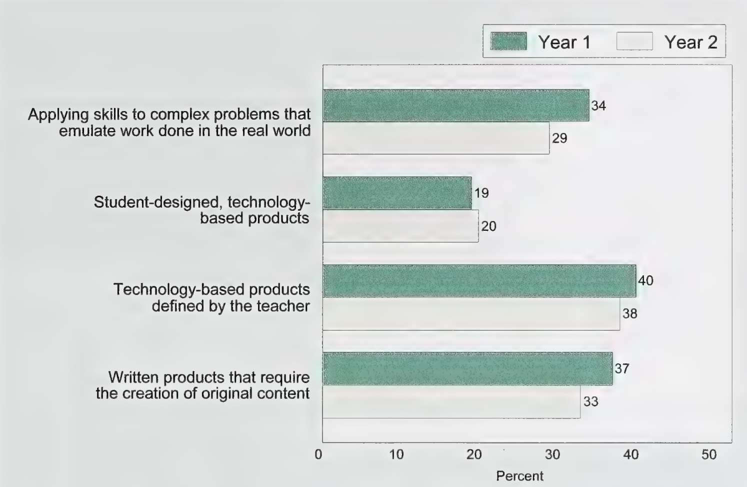
Figure 27 below.)

Figure 26. Percentage of classroom work in the following categories according to teacher



Year 1: *N*=108 teachers; Year 2: *N*=129 teachers

Figure 27: Percentage of work in classrooms in schools that falls in the following categories according to administrators:
Year 1: *N*=46 administrators; Year 2: *N*=46 administrators



While Emerge students are beginning to exhibit some progress in attainment of select 21st Century Skills, there remain indications from administrators that, in some classrooms, students do not yet have the opportunity to develop or demonstrate such attainment.

Dimension 4: 21st Century Learning Environments

Discussion

As Phil Schlechty (2002) says, *"Schools cannot be made great by great teacher performances. They will only be made great by great student performance."*[6]

Finding 4.5

Classroom practices in the Emerge program have shifted during the first two years toward 21st Century Learning, while maintaining a modicum of traditional, didactic teaching.

Finding 4.6

Nearly a third of Emerge teachers indicated that interactions with students' parents is "strongly facilitated by technology."

The *21st Century Learning Environment* Dimension is undoubtedly the most indicative of the progress the jurisdictions are making in changing classroom practices in ways that would advance 21st Century Learning. The researchers collected data on this dimension from the educators' surveys, the site visits, and the student surveys. Overall, classroom practices have shifted toward more student-centered learning, while maintaining some traditional, didactic teaching. That balance between basic versus higher order thinking, and between coaching and experiential learning versus didactic teaching, varies considerably across the Emerge jurisdictions and classrooms.

Emerge teachers and administrators survey responses in Spring 2009 placed Emerge in the Scaling Up stage of readiness for Dimension 4 (4.8 *on* an 8-point scale, as compared to the baseline score of 4.1 in Fall 2007). This topic is also addressed in Question 1, so the findings from that section should also be considered here. (See Finding 1.2.)

Spring 2009 Stage of Readiness: 21st Century Learning Environments

Awareness	*Exploration*	*Scaling Up*	*Systemic*
Teachers and school administrators are slowly building understanding of how classroom practices have to change. However, they have yet to act on those ideas, so practices look as they did a decade ago. In general, teaching is didactic, teachers are isolated, students are not engaged, they are passive learners, and they are graduating into a world unprepared for the 21st Century. At this stage, technology is often used in a supplemental way for drill and practice, note taking, or to increase productivity.	The leaders are asking all educators to dedicate time to acquiring deeper understanding of 21st Century Learning and to piloting those concepts in schools and classrooms. Pioneering groups are recognized for their innovations and their thoughtful reflections and applauded for documenting their work in order to share it. Leaders are beginning to schedule professional development aligned to the vision. A backward mapping or logic model is available, which clearly articulates pathways and essential conditions and characteristics of a school system that is ready to provide 21st Century Learning. That includes innovative uses of technology such as data collection and analysis, multimodal learning, critical and creative thinking, and collaborative learning.	Many classrooms and schools have been at least partially transformed into 21st Century Learning environments. A culture of high expectations, innovation, and enabling communities of practice is in place, along with metrics and accountability milestones to ensure incremental progress. Professional development is embedded in the school day, facilitated in part through reflective, active communities of learning. Leaders are building the capacity of all to meet and exceed the incremental goals and long-term vision.	Innovative communities of learning have been established in every site throughout the district. Within such cultures, educators have been empowered to shift practices in ways that fully engage students in deep, authentic learning, which is facilitated by thoughtful uses of technologies, including Web 2.0. Teachers are making collaborative decisions informed by research and professional literature, discussing and debating the concepts with colleagues, and then jointly shifting practices. Students and teachers have access to resources 24/7 via technology. Students are guided by teachers in self and peer assessment.

4.8 (an increase from 4.1 in Fall 2007)

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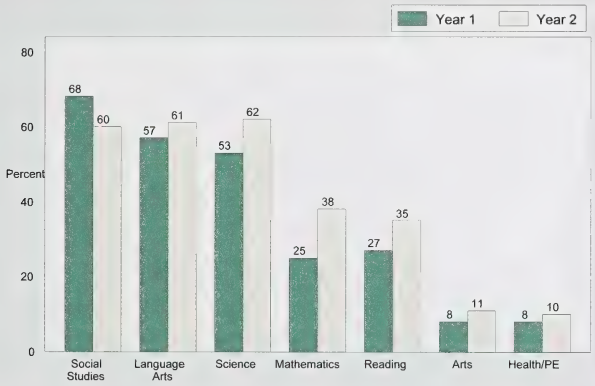
[6] Schlechty, P. (2002). Working on the Work: An Action Plan for Teachers, Principals and Superintendents. p. xvi.

Teachers in the Emerge program have made significant strides toward 21^{st} Century Learning. They now understand more clearly what the vision looks like, translated into practice. For example, the percentage of teachers agreeing or strongly agreeing with the statement that "Teachers in the Emerge program know what the school's expectations are for student attainment of 21^{st} Century Learning," increased from 67% in Year 1 to 92% in Year 2.

The percentage of teacher reporting that technology played a significant role in the core content areas increased significantly over the first two years of the program for all areas except social studies (which remained high despite a small decrease from Year 1 to Year 2. For the core areas of reading, language arts, mathematics, science, and social studies, the reports of significance for Year 2 were, respectively, +35%, +61%, +38%, +62%, and +60%. See Figure 28.

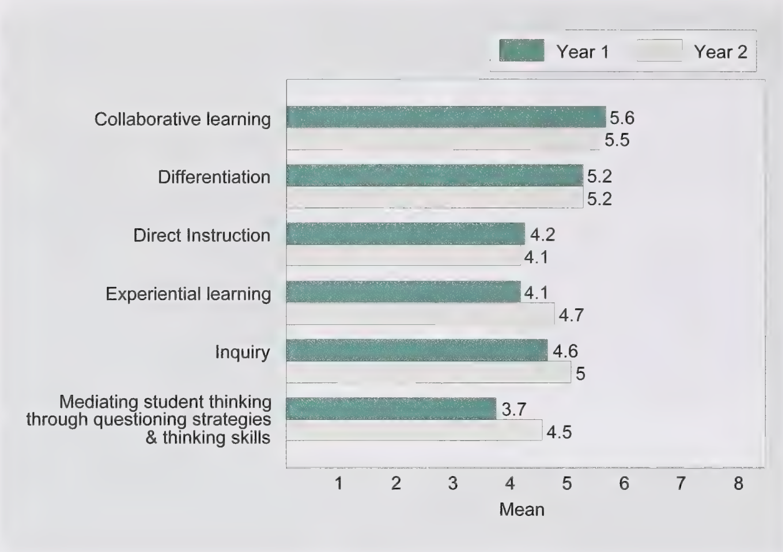
Figure 28. Trends in the percentage of teachers indicating that technology plays a moderate or significant role in building skills of proficiency in their students in the following content areas.



Year 1: N=108 teachers; Year 2: N=129 teachers

Emerge teachers continue to indicate that student-centered learning is important and they are making progress in incorporating student-centered pedagogies into their classrooms.

Figure 29: Trends in teachers' ratings as to the current use of various instructional strategies



Year 1: *N*=108 teachers; Year 2: *N*=129 teachers

It should also be noted that the gap between teachers' original perception of how important the instructional strategies are to 21st Century Learning, and the current use, has decreased over the three years. According to administrators, their school's current use of three key approaches to learning, seriously lag behind the level of importance they place on these skills for today's learners:

- Solving of real-world problems
- The use of the Internet to collaborate with students within the district, school, or classroom
- Online communication with experts, peers, and others

An area where teachers noted gains was in parental and community involvement that was strongly facilitated through technology. For example, 33% of teachers in Spring 2009 said that technology strongly facilitated interactions with parents, up from only 18% in Fall 2007.

Dimension 5: Educator Proficiency in 21st Century Learning

Finding 4.7
Teacher proficiency with technology in advancing academic proficiency and 21st Century Skills has increased over the two years of Emerge.

Discussion
According to Stanford professor, Linda Darling-Hammond, *"It is teachers who have a major influence on the most valuable asset a nation has – its youth."*[7]

This dimension of educator proficiency evaluates the proficiency of teachers in using technology and 21st Century Learning in lesson design, classroom activities, student assessment, and professional practice. While their proficiency with technology is important, the true indication is how teachers are able to combine strong pedagogy that supports student-centered learning, emergent research from the learning sciences on how people best learn, and features of contemporary technologies.

Teachers and administrators survey responses in Spring 2009 placed Emerge in the Scaling Up stage of readiness for Dimension 5 (5.4 on an 8-point scale, as compared to the baseline score of 4.7 in Fall 2007).

Spring 2009 Stage of Readiness: Educator Proficiency in 21st Century Learning

Awareness	*Exploration*	*Scaling Up*	*Systemic*
While teachers are aware of the concept of 21st Century Skills, there is a misconception that these skills have to do with technology alone. While teachers may have some proficiency in more traditional practices for building the skills, the connection of those practices to 21st Century Skills and Learning has not been made.	Teachers are beginning to understand the nature of 21st Century Skills and Learning but are only in initial stages of professional development to help them understand the cognitive science related to these skills. They are beginning to experiment with practices that promote 21st Century Skills but feel the need to expand their knowledge.	Formal professional development in 21st Century Skills and Learning is increasingly available. Teachers are fluent in the language of 21st Century Skills and Learning and assistance in building skill for supportive practices and opportunities to evaluate personal readiness for those practices are widely available.	All teachers are expected to be expert both in knowledge of the science related to 21st Century Skills and Learning and in the practices known to develop these skills. These concepts have been embedded in all professional development related to teaching and learning and teacher skill in this area can be observed in virtually every classroom.

5.4 (compared to 4.7 in Fall 2007)

Comprehensive professional growth opportunities need to be available for educators to build their capacity to advance the Emerge vision. Emerge educators have participated in various jurisdictional and provincial professional learning opportunities. Further, they have been actively involved in sharing their expertise through various presentations. Many jurisdictions have established supports for their own local community of practice. For example, one jurisdiction created an online space in Google Docs that includes: a list of team members; project news; research; journal entries; professional learning events; files to share; and a calendar. Within the section, "Professional Learning Events," teachers in each school record the professional learning activities they plan to participate in. After attending the activity they note some information about the learning experience. This ongoing record reflects the diverse nature of the professional learning that individuals have engaged in as part of building capacity.

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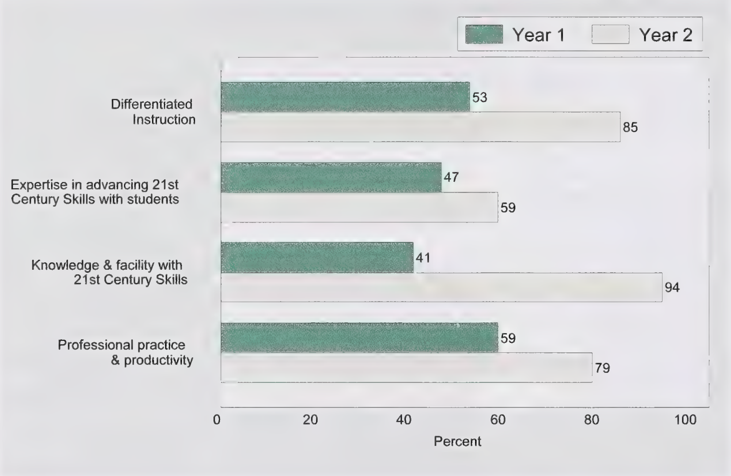
[7] Davie, S. (2009, August 30). Teachers' Champ. *The Straits Times*. Retrieved December 10, 2009, from http://www.asiaone.com/News/Education/Story/A1Story20090827-163781.html.

This online environment has been created to support educators and provide them with a space to share their work and reflections. Further, they can share exemplars of student work that show the various types of activities and projects students are engaged in with the use of their laptops. Such an online environment fosters greater communication about the one-to-one laptop project, as well as what individuals are doing to advance their own work and the work within the Emerge initiative.

Extensive professional development opportunities, including such communities of practice have contributed to the incremental increases in teacher proficiency among Emerge teachers. As shown in Figure 30, most administrators agree that teachers are prepared to teach 21st Century Skills.

Figure 30. Percentage of administrators' reporting that teachers are prepared to teach the following 21st Century Skills



N=46 administrators (Years 1 and 2)

Dimension 6: Access and Infrastructure

Discussion

From the Emerge program's inception, *Access and Infrastructure* has been a leading indicator. Due to the nature of the Emerge One-to-One Laptop Project, a large-scale infusion of technology was the first action of all of the Emerge jurisdictions. During the first year of the initiative most jurisdictions dedicated significant resources and personnel in providing one-to-one laptop computers and wireless network environments with sufficient access to support Emerge instructional programs. That said, there are still some programs where sufficiency has not been achieved, according to teachers.

The Emerge teachers and administrators survey responses in Spring 2009 placed Emerge in the Scaling Up stage of readiness for Dimension 6 (5.7 on an 8-point scale, as compared to the baseline score of 5.5 in Fall 2007).

Finding 4.8

Emerge teachers and administrators report having adequate access to computers and other peripherals, but do report some gaps in the access to more specialized technologies and to ongoing supplies (e.g., batteries, etc.).

Finding 4.9

While the majority of Emerge teachers report having access to fast reliable Internet connections, there remains a significant percentage (29%) of Emerge teachers who report less than adequate access, with reliability of the Internet more problematic than speed.

Spring 2009 Stage of Readiness: Access and Infrastructure

Awareness	*Exploration*	*Scaling Up*	*Systemic*
Access to technology and the infrastructure in place in the school is not sufficient to support rich, authentic 21st Century Learning. Technology problems and the lack of "just-in-time" availability reinforce the need for the status quo. Pioneers who attempt to implement innovative 21st Century Learning practices become frustrated with technological roadblocks.	Some elements of a comprehensive tech-ready environment are in place, often in support of grants or pilot initiatives. Planning processes are in place to support increased access and improved client support, but these processes will take time. Systems to provide seamless access to date are being envisioned, but do not currently exist.	Elements of a technically sophisticated, 21st Century teaching and learning environment have been planned for and are being rolled out. Data systems are in place and staff are beginning to use these systems in powerful ways. Tech support is increasingly available as needed, but may still be oriented more toward accomplishing the plan than meeting end-user needs.	Visitors to the school or district immediately recognize a 21st Century environment. Technology access is seamless and ubiquitous. All stakeholders have immediate access to the data that they need to support teaching and learning and problems are immediately solved through service-oriented support. New technologies are quickly evaluated and where found to be valuable, are incorporated in well-organized refresh cycles.

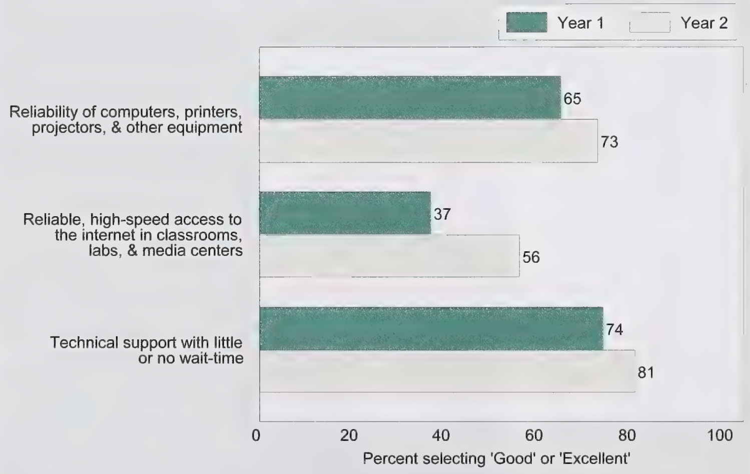
→ **5.7** (compared to 5.5 in Fall 2007)

The Emerge classrooms in general have the adequate computers, laptop computers, LCD projectors, digital cameras, and digital white boards to meet current needs. However, they do report inadequate access to personal digital assistants, document cameras, scanners, scientific probes, and robotics kits as well as some supplies such as batteries. Data from the site visits confirmed that some additional digital equipment had been purchased (e.g., cameras, video recorders, and microphones) in response to the instructional needs in the classroom, and that generally stakeholders felt they have enough technology.

High percentages of Emerge administrators reported adequate, good, or excellent access to technologies and technical support services. Those percentages have increased over time, as seen in Figure 31. Throughout the first year and into the second year, work continued by the jurisdictions to increase access, address technical issues or increase their ability to more quickly log onto the network. In this second year, jurisdictions found that the maturity of the technology brought with it maintenance issues such as batteries needing to be replaced, the need for additional chargers, and general repairs from simple wear and tear on some laptops.

A range of software and applications are being used to support student learning. Word processing and presentation software are used substantially, along with the use of the Internet for research and for access to web-based learning activities. Further, software for editing video, graphics and sound editing or production is being used as students are learning and creating in multimodal environments. The use of other communication tools such as instant messaging discussion boards, and videoconferencing continued to be used within various learning environments. In Spring 2009, examples of social networking, blogs, and wikis were being used to support student learning.

Figure 31. Trends in administrators' ratings of access, technical support, and infrastructure



N=46 administrators (Years 1 and 2)

Overall, teachers felt they did have good technical support, however as more computers and interactive whiteboards were installed in the jurisdictions, in Emerge classrooms and beyond, the technical support tended to be stretched further and further, which in some cases reduced support for the Emerge project.

Dimension 7: Accountability/Results

Discussion

The accountability dimension looks at the alignment between vision, goals, assessments, and results, plus the degree to which all educators in the system understand standards for results, and, finally, the results themselves.

This was the lowest scoring dimension in Year 1, at 3.9 out of 8 points in the D21™ scale, placing it in the Exploration stage. This was due, in large part, to the new territory that 21st Century Skills represented for many of the Emerge jurisdictions. Through professional communities of practice sessions, webinars, and other professional development sessions, most jurisdictions are incrementally making progress in this dimension.

Finding 4.10

The percentage of teachers who reported their students clearly understood what would be required to demonstrate their attainment of 21st Century Skills increased from Year 1 to Year 2. Many teachers are using rubrics for the assessment for and of 21st Century Learning.

[See also Finding 1.1 Repeated here]

Student expertise with 21st Century Skills has increased over the course of the two-year program, with the highest levels of such expertise registered in teaming and collaboration and interactive communication, and the greatest gains from Year 1 to Year 2 in global awareness and productivity related to the effective use of real-world tools.

The Emerge teachers and administrators survey responses in Spring 2009 placed Emerge in the Scaling Up stage of readiness for Dimension 7 (4.5 on an 8-point scale, as compared to the baseline score of 3.9 in Fall 2007).

Spring 2009 Stage of Readiness: Accountability/Results

Awareness	*Exploration*	*Scaling Up*	*Systemic*
The district has a vision in place, but has not yet back mapped that vision into a logic model that clearly shows what needs to happen in order to achieve the vision. At this stage, leaders are investigating what matters in terms of readiness for 21st Century Learning and how to measure the critical readiness and outcomes measures for 21st Century Learning.	At this stage educators are beginning to identify what it takes to lead, learn, and teach for 21st Century Learning. They are also investigating new ways of measuring each of those elements (e.g., performance assessments to measure authentic work by students; team projects to measure collaboration, etc.). They are piloting new metrics and analyzing results.	The district is ready to document the elements of leading, learning, and teaching in the 21st Century. They have also identified and selected the metrics to measure both student outcomes and system indicators of progress toward these goals. They are in the process of communicating these definitions and metrics to all stakeholders and implementing a process that sets expectations, builds capacity for meeting those expectations, easily captures and makes available data on the metrics, and sets in motion a process for aligning all these elements into an accountability system that is set in motion.	All stakeholders are held accountable for high performances related to the district's vision for 21st Century Learning. The district has clearly articulated what is expected at all levels, in every facet of 21st Century teaching, learning, and leading. Leaders have prioritized funding to ensure strong support. The district has metrics, measures, and processes in place to ensure accountability. Data-driven decision making is embedded in the culture and is informing decision making and progress. As a result, the district is tracking outcomes for 21st Century leading, learning, and teaching, and is seeing progress toward the goals.

4.5 (compared to 3.9 in Fall 2007)

This dimension is at the lower stages of scaling up. Within the Emerge program, teachers and administrators have indicated –through surveys–– that the vision has been established, there is an expectation that teachers integrate the vision into their daily lesson design, and many teachers are using rubrics to assess progress with 21st Century Skills and effective uses of technology.

Another measure of accountability is collected during the site visits, through student artifact reviews, and interviews with teachers. Generally, those measures indicated scores on the border of exploration and scaling up. For example, each school jurisdiction submitted three student artifacts to be scored in terms of 21st Century Learning, authenticity, construction of knowledge and sophistication of technology use, all of which registered some increases over time, but remained at moderate levels.

Similar levels were recorded during classroom observations. The artifacts submitted at the end of the second year reflect the product of a shift in the design of learning, along with how the technology is used to present and represent student understandings.

In terms of Accountability, jurisdictions and schools are aligning the vision and expectations of classroom teachers to implement that vision in the Emerge classrooms. While many teachers have also aligned student assessment (in the form of rubrics) to that expectation, that movement has not generally been systemic. Many teachers are using rubrics to assess 21st Century Learning. Many are also using those rubrics with students to define 21st Century Skills and 21st Century Learning products to guide students' ongoing work. Some are also facilitating the development of student rubrics for use in assessment for learning.

21st Century Artifact

The richness of student engagement in learning was observed in an artifact that was a culminating activity for an integrated unit of study. Students created a video to address the inquiry question, "What does it mean to be Canadian?" All students participated in making the I-Movie using a news program format. They conducted interviews, captured events, and performed small scenes in the video to present an array of responses to the question. The authenticity of the work, the collaboration and teaming, the creative thinking, and the use of technology to demonstrate their understanding of this inquiry question is reflective of 21st Century Learning.

One of the key challenges for sustainability in this area is the segmentation of the Emerge program from the mainstream of the school. Until the entire school system adopts the Emerge vision – or develops its vision for 21st Century Learning – and begins to systemically implement and assess that vision school wide and jurisdiction wide, it will be difficult to sustain Emerge.

Recommendations Related to Question 4:

What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?

Recommendation 4a:
During the last year of the Emerge program, educators should focus on moving all indicators into the systemic category, based on their Year 2 reports from the researchers.

Recommendation 4b:
Emerge exemplars from curriculum, instruction, and assessment practices should be documented and shared.

Recommendation 4c:
Emerge leaders should expand the virtual communities of practice concept to promote collaborations and exchanges across the Emerge jurisdictions.

The recommendations in Sections 1-3 also address some of the finding in this section.

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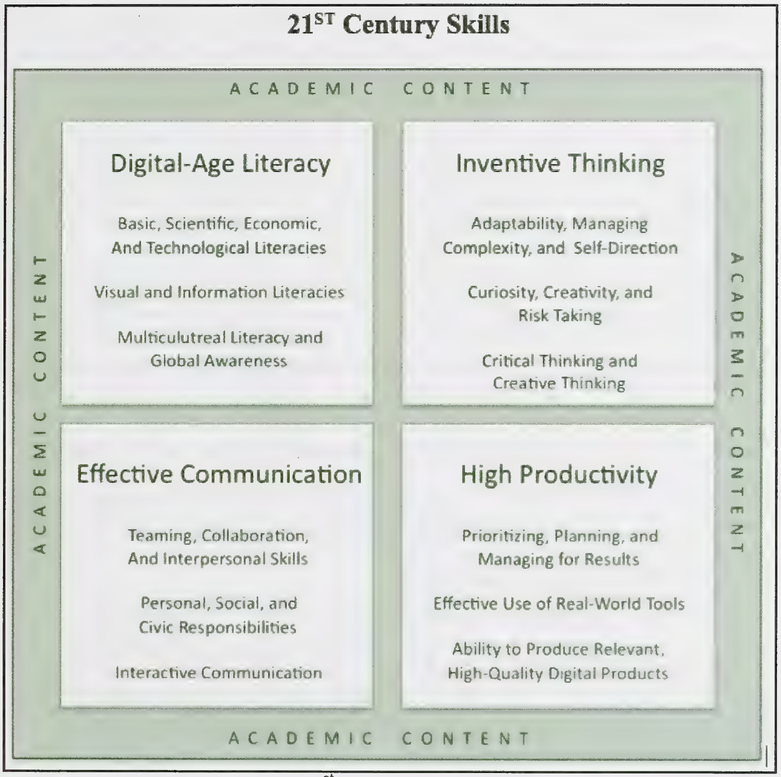
Appendix A: 21^{st} Century Skills

Many of the Emerge proposals that were funded through Emerge used the enGauge framework for 21^{st} Century Skills. That framework defines the 21^{st} Century Skills as follows.



21^{ST} Century Skills

ACADEMIC CONTENT

Digital-Age Literacy
- Basic, Scientific, Economic, And Technological Literacies
- Visual and Information Literacies
- Multiculutreal Literacy and Global Awareness

Inventive Thinking
- Adaptability, Managing Complexity, and Self-Direction
- Curiosity, Creativity, and Risk Taking
- Critical Thinking and Creative Thinking

Effective Communication
- Teaming, Collaboration, And Interpersonal Skills
- Personal, Social, and Civic Responsibilities
- Interactive Communication

High Productivity
- Prioritizing, Planning, and Managing for Results
- Effective Use of Real-World Tools
- Ability to Produce Relevant, High-Quality Digital Products

Source: enGauge Framework for 21^{st} Century Learning

A definition for each skill follows:

Digital-Age Literacy includes:

- ***Basic Literacy:*** Language proficiency (in English) and numeracy at levels necessary to function on the job and in society to achieve one's goals, and develop one's knowledge and potential in this Digital Age.
- ***Scientific Literacy:*** Knowledge and understanding of the scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity

- ***Economic Literacy:*** The ability to identify economic problems, alternatives, costs, and benefits; analyze the incentives at work in economic situations; examine the consequences of changes in economic conditions and public policies; collect and organize economic evidence; and weigh costs against benefits

- ***Technological Literacy:*** Knowledge about what technology is, how it works, what purposes it can serve, and how it can be used efficiently and effectively to achieve specific goals

- ***Visual Literacy:*** The ability to interpret, use, appreciate, and create images and video using both conventional and 21st century media in ways that advance thinking, decision-making, communication, and learning

- ***Information Literacy:*** The ability to evaluate information across a range of media; recognize when information is needed; locate, synthesize, and use information effectively; and accomplish these functions using technology, communication networks, and electronic resources

- ***Multicultural Literacy:*** The ability to understand and appreciate the similarities and differences in the customs, values, and beliefs of one's own culture and the cultures of others

- ***Global Awareness:*** The recognition and understanding of interrelationships among international organizations, nation-states, public and private economic entities, socio-cultural groups, and individuals across the globe

Inventive Thinking is comprised of the following "life skills":

- ***Adaptability/Managing Complexity:*** The ability to modify one's thinking, attitude, or behavior to be better suited to current or future environments, as well as the ability to handle multiple goals, tasks, and inputs, while understanding and adhering to constraints of time, resources, and systems (e.g., organizational, technological)

- ***Self-Direction:*** The ability to set goals related to learning, plan for the achievement of those goals, independently manage time and effort, and independently assess the quality of learning and any products that result from the learning experience

- ***Curiosity:*** The desire to know or a spark of interest that leads to inquiry

- ***Creativity:*** The act of bringing something into existence that is genuinely new and original, whether personally (original only to the individual) or culturally (where the work adds significantly to a domain of culture as recognized by experts)

- ***Risk-taking:*** The willingness to make mistakes, advocate unconventional or unpopular positions, or tackle extremely challenging problems without obvious solutions, such that one's personal growth, integrity, or accomplishments are enhanced

- ***Higher-Order Thinking and Sound Reasoning:*** Include the cognitive processes of analysis, comparison, inference/interpretation, evaluation, and synthesis applied to a range of academic domains and problem-solving contexts

Effective Communication involves:

- ***Teaming and Collaboration:*** Cooperative interaction between two or more individuals working together to solve problems, create novel products, or learn and master content

- ***Interpersonal Skills:*** The ability to read and manage the emotions, motivations, and behaviors of oneself and others during social interactions or in a social-interactive context

- ***Personal Responsibility:*** Depth and currency of knowledge about legal and ethical issues related to technology, combined with one's ability to apply this knowledge to achieve balance, integrity, and quality of life as a citizen, a family and community member, a learner, and a worker

- ***Social and Civic Responsibility:*** The ability to manage technology and govern its use in a way that promotes public good and protects society, the environment, and democratic ideals

- ***Interactive Communication:*** The generation of meaning through exchanges using a range of contemporary tools, transmissions, and processes

High Productivity is currently not a high-stakes focus of schools, yet the skills involved in this cluster often determine whether a person succeeds or fails in the workforce:

- ***Prioritizing, Planning, and Managing for Results:*** The ability to organize to efficiently achieve the goals of a specific project or problem

- ***Effective Use of Real-World Tools:*** Effective use of these tools – the hardware, software, networking, and peripheral devices used by Information Technology (IT) workers to accomplish 21st century work – means using these tools to communicate, collaborate, solve problems, and accomplish tasks

- ***Ability to Produce Relevant, High-Quality Products:*** Intellectual, informational, or material products that serve authentic purposes and occur as a result of students using real-world tools to solve or communicate about real-world problems. These products include persuasive communications in any media (print, video, the Web, verbal presentation), synthesis of resources into more useable forms (databases, graphics, simulations), or refinement of questions that build upon what is known to advance one's own and others' understanding

Appendix B: Data tables

Table 11. SLI subscale scores by time and level

Level	SLI Subscales	Time 1 Mean (SD)	Time 2 Mean (SD)	Sig
Elementary (n=251)	Forethought	5.06 (1.0)	4.84 (1.2)	**
	Performance/Volitional Control	5.06 (1.1)	5.04 (1.1)	
	Self-Reflection	5.41 (1.0)	5.2 (1.1)	**
Secondary (n=386)	Forethought	4.34 (1.0)	4.14 (1.0)	**
	Performance/Volitional Control	4.89 (1.0)	4.44 (0.9)	**
	Self-Reflection	4.89 (1.0)	4.77 (0.9)	*
Switched Levels (n=124)	Forethought	4.6 (0.9)	4.33 (1.0)	**
	Performance/Volitional Control	5.0 (1.1)	4.65 (0.8)	*
	Self-Reflection	5.02 (0.9)	4.89 (1.0)	

Table 12. Descriptive statistics for the Cognitive subscale by time and level

	Elementary (*n* =318)		**Secondary** (*n* =486)		**Switched Levels** (*n* =214)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Mean:	4.06	3.91	3.43	3.22	3.63	3.32
Std. Dev.:	.72	.83	.77	.84	.71	.77
N Pairs:	318		486		214	
Mean Difference:	.153		.215		.307	
SE of Diff.:	.042		.032		.051	
T-Score:	3.660		6.676		5.966	
P:	.000 **		.000 **		.000 **	

Table 13. Descriptive statistics for the Emotional subscale by time and level

	Elementary (*n* =318)		**Secondary** (*n* =486)		**Switched Levels** (*n* =212)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Mean:	4.23	4.06	3.77	3.52	3.93	3.50
Std. Dev.:	.80	.95	.87	.91	.85	.93
N Pairs:	318		486		212	
Mean Difference:	.167		.253		.432	
SE of Diff.:	.049		.035		.061	
T-Score:	3.370		7.202		7.066	
P:	.001 **		.000 **		.000 **	

Table 14. Descriptive statistics for the Behavioral subscale by time and level

	Elementary (*n* =206)		**Secondary** (*n* =339)		**Switched Levels** (*n* =194)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Mean:	3.74	3.85	3.62	3.48	3.56	3.47
Std. Dev.:	.78	.76	.75	.79	.75	.82
N Pairs:	206		339		194	
Mean Difference:	.103		.137		.083	
SE of Diff.:	.059		.038		.060	
T-Score:	1.746		3.659		1.379	
P:	.082		.000 **		.169	

Table 15. Total SLI scores by level

	Elementary (*n* =251)		**Secondary** (*n* =386)		**Switched Levels** (*n* =124)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Mean:	5.18	5.03	4.71	4.45	4.87	4.62
SD:	.82	1.05	.76	.84	.69	.86
N pairs:	251		386		124	
Mean Difference:	.150		.258		.249	
SE of Diff.:	.057		.037		.080	
T-Score:	2.649		6.887		3.118	
P:	.009 *		.000 **		.002 *	

Table 16. SLI scores for all students by time

		Time 1 (*N* =1,016)	**Time 2** (*N* =1,016)	Sig
Behavioral	Mean (SD)	3.66 (0.75)	3.59 (0.81)	**
	Median	3.67	3.67	
Emotional	Mean (SD)	3.95 (0.87)	3.68 (0.96)	**
	Median	4.14	3.71	
Cognitive	Mean (SD)	3.67 (0.79)	3.45 (0.87)	**
	Median	3.71	3.43	

Table 17. CSES Overall score by level by time

	Elementary (*n* =390)		**Secondary** (*n* =606)		**Switched Levels** (*n* =168)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Mean:	3.75	3.71	3.40	3.26	3.59	3.41
Std. Dev.:	.46	.49	.43	.52	.41	.47
N Pairs:	390		606		168	
Mean Difference:	.038		.133		.176	
SE of Diff.:	.023		.017		.034	
T-Score:	1.642		7.627		5.132	
P:	.101		.000 **		.000 **	

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